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TM 5-4310-451-14&P

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

(Including Repair Parts Information and Supplemental Maintenance and Repair Parts Instructions)

COMPRESSOR, AIR, ROTARY SCREW, 750 CFM 100 PSI, WHEEL MOUNTED, DED (CCE)

SULLAIR MODEL 750 DP

NSN 4310-01-053-3891

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

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CHANGE
NO. 2

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, DC, 9 February 1984

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL

(Including Repair Parts Information and Supplemental Maintenance and Repair Parts Instructions)

COMPRESSOR, AIR, ROTARY SCREW, 750 CFM, 100 PSI, WHEEL MOUNTED, DED

(CCE)

SULLAIR MODEL 750DP

NSN 4310-01-053-3891

TM 5-4310-451-14&P, December 14, 1979 is changed as follows:

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VOLUME 1 SECTION 5
Illustrations and parts list

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VOLUME 3
Engine parts list

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By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25A, Operator maintenance requirements for Air Compressors, 600 CFM.

CHANGE }
No. 1 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *31 October 1980*

Operator's, Organizational, Direct Support General Support and Depot Maintenance Manual (Including Repair Parts Information and Supplemental Maintenance and Repair Parts Instructions)
For
COMPRESSOR, AIR, ROTARY SCREW, 750 CFM, 100 PSI, WHEEL MOUNTED, DED
(CCE)
SULLAIR MODEL 750DP
(NSN 4310-01-053-3891)

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The Adjutant General

Distribution:

ACTIVE ARMY, USAR, ARNG: To be distributed in accordance with DA Form 12-25A, Operator Maintenance requirements for Air Compressors, 600 CFM.

WARNING

SAFETY MEASURES FOR HANDLING HIGH-PRESSURE AIR SYSTEMS.

1. A maximum pressure of 150 psi may occur at the service air connection of this compressor, under certain circumstances. Select tools and air hoses, pipes, valves, filters and other fittings accordingly. Do not exceed manufacturer's rated safe operating pressures when selecting these items.

2. Secure all hose connections by wire, chain, or other suitable retaining devices, to prevent tools or hose ends from being accidentally expelled; and to prevent flailing, should a connection be accidentally broken.

3. Vent all internal pressure prior to opening any line, fitting, hose, valve, drain plug, connection, or other component.

4. Do not use air pressures higher than 30 psi for cleaning purposes; and then only with effective chip guarding and personal protective equipment.

5. Do not engage in horseplay with air hoses, as death or serious injury may result.

6. Don't kink, twist, walk on, run over, or jerk air hose.

7. Do not open compressor oil filler cap when compressor is running and pressurized. Shut down the compressor and bleed the sump (receiver) to zero psi before removing the filler cap.

WARNING

DANGEROUS NOISE LEVELS

1. Dangerous noise levels exist in the vicinity of an operating air compressor unit.

2. Make sure that you wear adequate ear protection. Permanent ear damage may result if exposed to this noise without adequate ear protection.

WARNING

SAFETY MEASURES FOR TOWING

1. Do not allow personnel to ride in or on the compressor.

2. Do not permit personnel to stand or ride on the drawbar or to stand or walk between the compressor and the towing vehicle.

3. Inspect drawbar and coupling device for defects such as excessive wear or corrosion, cracked, bent, dented, or otherwise deformed or degraded members, and for security of attachment.

4. Make sure the area behind the compressor is clear of all personnel and obstructions prior to backing.

WARNING

SAFETY MEASURES TO PREVENT FIRE AND EXPLOSION

1. When refueling, ground the compressor to the fuel dispenser prior to refueling.

2. Shut off the air compressor and allow it to cool before adding fuel.

3. Keep sparks, flames, and other sources of ignition out of the vicinity when adding fuel or checking batteries.

4. Disconnect the grounded (negative) battery connection prior to attempting any repairs or cleaning inside the enclosure.

5. Open all access doors and allow the enclosure to ventilate thoroughly, prior to attempting to start the engine.

6. Replace damaged fuel tanks or lines immediately, rather than attempting to weld or otherwise repair them. Do not attempt to operate this compressor with any known fuel system leaks.

7. Keep a suitable fully charged class BC fire extinguisher or extinguishers nearby when servicing and operating the compressor.

8. Turn off or disconnect the battery charger before making or breaking connections to the battery.

WARNING

SAFETY MEASURES TO BE USED AROUND MOVING PARTS

1. Do not operate the compressor with the fan guard removed.

2. Wear snug fitting clothing and confine long hair when working around this compressor, especially when you are exposed to moving parts inside the enclosure.

3. Make adjustments only when the engine is shut off. When necessary, make adjustments, then start engine to check adjustment. If not correct, shut off engine, readjust, then restart engine to recheck adjustment.

4. Make sure all personnel are out of and clear of the compressor before starting it.

5. Keep hands, arms, and other parts of your body away from belts, pulleys, and other moving parts.

WARNING

SAFETY MEASURES FOR TOXIC SUBSTANCES AND ELECTRICAL SHOCK

1. Operate the compressor only in open or well ventilated areas. If the machine is operated indoors, discharge engine exhaust fumes outdoors.

2. Wear an apron and a face shield or goggles when servicing the battery. Flush spilled electrolyte from skin or clothing with large quantities of water.

3. Keep the towing vehicle, compressor, hoses, tools, and all personnel at least 10 feet from power lines and buried cable.

4. Keep all parts of the body and any hand held tools or other conductive objects away from exposed parts of the electrical system. Maintain dry footing, stand on insulated surface, and do not contact any other part of the compressor, when making adjustments or repairs to the compressor electrical system.

WARNING

SAFETY MEASURES FOR LIFTING THE COMPRESSOR

1. Use guide ropes to prevent twisting or swinging.
2. Do not attempt to lift the compressor in high winds.
3. Keep all personnel out from under and away from the compressor when it is suspended.

WARNING

SAFETY MEASURES TO BE USED WHEN JUMP STARTING THE COMPRESSOR ENGINE

1. The batteries contain hydrogen gas which is flammable and explosive. Keep flame, sparks, and other sources of combustion away from the batteries.
2. Wear an apron and face shield when attempting to jump start the compressor.
3. Do not jump start if battery electrolyte is slushy or frozen.

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TECHNICAL MANUAL

No. 5-4310-451-14 & P

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, DC, 14 December 1979

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL
(Including Repair Parts Information and Supplemental Maintenance and Repair Parts Instructions)

COMPRESSOR, AIR, ROTARY SCREW, 750 CFM, 100 PSI, WHEEL MOUNTED, DED
(CCE)
SULLAIR MODEL 750DP
NSN 4310-01-053-3891

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Tank-Automotive Command, ATTN: DRSTA-MB, Warren, MI 48090. A reply will be sent to you.

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This technical manual is an authentication of the manufacturers' commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

Volume 1
Operators Manual and Parts List

750 CFM Rotary Screw Air Compressor

Stock Number 4310-01-053-3891
Contract DSA700-77-C-8407

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Section A
SAFETY

A.1 GENERAL

Sullair Corporation designs and manufactures all of its products so they can be operated safely. However, the responsibility for safe operations rests with those who use and maintain our products. The following safety precautions are offered as a guide, which, if conscientiously followed, will minimize the possibility of accidents throughout the useful life of this equipment.

This air compressor should be operated only by those who have been trained and delegated to do so, and who have read, and who understand this operators manual. Failure to follow the instructions, procedures, and safety precautions in this manual can result in accidents and injuries.

Never start this air compressor unless it is safe to do so. Do not attempt to operate the air compressor with a known unsafe condition. Tag the air compressor so others who may not know of the unsafe condition will not attempt to operate it until the condition is corrected.

Use and operate this air compressor only in full compliance with all pertinant O.S.H.A. requirements and all pertinant Federal, State, and Local Codes or requirements.

A.2 TOWING

A. PREPARING TO TOW:

1. Inspect drawbar and coupling device for defects such as excessive wear or corrosion, cracked, bent, dented, or otherwise deformed or degraded members, and for security of attachment.

2. Make sure the coupling device on the towing vehicle is rated for towing a vehicle of at least 11,000 lb. (5,000kg.).

3. Make sure the coupling device is fully engaged, closed, and locked.

4. Make sure the coupling device provides freedom of rotation in both the horizontal and vertical planes, of the drawbar eye within the coupling device, when engaged.

5. Make sure that no part of the coupling device or towing vehicle restricts motion of the drawbar that will be encountered while towing or backing.

6. Make sure tires are in good condition and inflated to 60 PSIG, (414 kPa).

7. Make sure wheel bolts are torqued to 80-90 ft. lb., (108-121N.m.).

8. Make sure all air hoses are disconnected.

9. Make sure all access doors are closed and latched.

10. Make sure wheels are not chocked or blocked.

11. Release parking brakes.

B. TOWING:

1. Observe all local and Federal traffic laws, including those specifying minimum speed.

2. Tow at speeds less than 15 M.P.H., (24 Km. P.H.) under ideal conditions. Reduce speed accordingly, as directed by posted signs, weather, or road or terrain conditions.

3. Avoid grades in excess of 15°, (27%).

4. Avoid pot holes, rocks, and other obstructions, and soft shoulders, or unstable terrain.

5. Whether towing forward or backing, maneuver in a manner that will not exceed the freedom of rotation of the drawbar within the coupling device, in either the horizontal or vertical planes.

6. Make sure no personnel are riding in or on the compressor.

7. Make sure the area behind the compressor is clear of all personnel and obstructions, prior to backing.

8. Do not permit personnel to stand or ride on the drawbar or to stand or walk between the compressor and the towing vehicle.

C. PARKING:

1. Park on level area, if possible. If not, park across grade, so the compressor will not roll down hill. Do not park on grades exceeding 15°, (27%).

2. Make sure compressor is parked on a firm surface that can support its weight.

3. Park compressor so the wind, if any, tends to carry the exhaust fumes away from personnel and away from the compressor air inlet openings, and also where the compressor will not be exposed to excessive dust from the work site.

4. Park compressor with front wheels in straight ahead position.

5. Set parking brakes.

6. Block both front and rear of all four wheels.

7. Disconnect coupling device and move towing vehicle clear of compressor.

8. Erect hazard indicators, barricades, or flares (if at night), if compressor is parked adjacent to public roads.

A.3 PRESSURE RELEASE:

A. Manually pop the pressure relief valve at least weekly, to make sure it is not blocked, closed, obstructed, or otherwise inoperative.

B. Install an appropriate flow limiting protective check valve between the compressor service air outlet and the shut-off (throttle) valve, when an air hose exceeding 1/2" inside diameter is to be connected to the shut-off (throttle) valve, to reduce presssure in case of hose failure.

C. When the hose in item B above is used to supply a manifold, install an additional appropriate flow limiting protective check valve between the manifold and the shut-off (throttle) valve, for each air hose exceeding 1/2" inside diameter that is connected to a shut-off (throttle) valve on the manifold. This also, is to reduce pressure in case of hose failure.

D. When any run of air hose must exceed 75 feet in length, install an additional appropriate flow limiting protective check valve on the free end of the hose connected to the compressor or manifold, for each additional 75 feet or less of hose to be connected to the first, for each air hose exceeding 1/2" inside diameter, to reduce pressure in case of hose failure.

E. Flow limiting protective check valves are listed by pipe size and rated CFM. Select appropriate valves accordingly.

F. A maximum pressure of 150 PSIG (1034 kPa) may occur at the service air connection of this compressor, under certain circumstances. Select tools, and air hoses, pipes, valves, filters and other fittings accordingly. Do not exceed manufacturer's rated safe operating pressures, when selecting these items.

G. Secure all hose connections by wire, chain, or other suitable retaining devices, to prevent tools or hose ends from being accidently expelled; and to prevent flailing, should a connection be accidently broken.

H. Open oil filler cap only when compressor is not running and is not pressurized. Shut-down the compressor and bleed the sump (receiver) to zero P.S.I.G. before removing the cap.

I. Vent all internal pressure prior to opening any line, fitting, hose, valve, drain plug, connection, or other component.

J. Keep personnel out of line with, or away from, the discharge opening of hoses, tools, or other points of discharge.

K. Do not use air at pressures higher than 30 P.S.I.G., (207 kPa) for cleaning purposes; and then only with effective chip guarding and personal protective equipment.

L. Do not engage in horseplay with air hoses, as death or serious injury may result.

M. Do not remove radiator filler cap while the cooling system is hot or warm. Allow the system to cool to the ambient temperature, then loosen cap slowly to its stop, to relieve any excess pressure, before removing cap completely.

A.4 FIRE AND EXPLOSION:

A. Refuel at a service station or from a fuel truck designed for its intended purpose. If this is not possible, ground the machine to the dispenser prior to refueling.

B. Clean up spills of fuel, oil, or coolant immediately, when such spills occur.

C. Shut off the air compressor and allow it to cool. Keep sparks, flames, and other sources of ignition out of the vicinity when adding fuel. When checking the level of or adding electrolyte to the batteries, or when checking the level of or adding fuel or oil, do not permit smoking in or near the area.

D. Do not permit liquids or oil film to accumulate on the bottom covers, acoustical material, or any external or internal surfaces of the air compressor. Wipe down, using an aqueous industrial cleaner, or steam clean, as required. If necessary, remove acoustical material, clean all surfaces, and then replace acoustical material. Do not clean the aluminum oil cooler with caustics. Do not use flammable solvents for cleaning purposes.

E. Disconnect the grounded (negative) battery connection prior to attempting any repairs or cleaning inside the enclosure.

F. Keep electrical wiring, including the battery terminals, in good condition. Replace any wiring that has cracked, cut, abraded or otherwise degraded insulation, or that has worn, discolored, or corroded terminals. Keep all terminals clean and tight.

G. Open all access doors and allow the enclosure to ventilate thoroughly prior to attempting to start the engine.

H. Keep grounded conductive objects away from exposed live electrical parts.

I. Replace damaged fuel tanks or lines immediately, rather than attempting to weld or otherwise repair them. Do not store indoors, or attempt to operate this compressor with any known fuel system leaks.

J. Prior to attempting weld repairs, remove any acoustical material or other material in close proximity that may be damaged by heat, or support combustion.

K. Keep a suitable fully charged class BC fire extinguisher or extinguishers nearby when servicing and operating the compressor.

L. Keep oily rags, trash, leaves, litter, or other combustibles out of and away from the compressor.

M. Turn off or disconnect battery charger before making or breaking connections to the battery.

N. Do not operate compressor under low overhanging leaves, or permit such leaves to contact hot exhaust system surfaces, when operating the compressor in forested areas.

O. Equip the exhaust system with approved spark arrestors whenever required by State or local codes.

A.5 MOVING PARTS

A. Keep hands, arms, and other parts of the body away from belts, pulleys, and other moving parts.

B. Do not attempt to operate the compressor with the fan guard removed.

C. Wear snug fitting clothing and confine long hair when working around this compressor, especially when exposed to moving parts inside the enclosure.

D. Keep access doors closed, except when making repairs or adjustments, starting or stopping the compressor, or performing service functions.

E. Make sure all personnel are out of and clear of the compressor prior to attempting to start or operate it.

F. Shut off engine before adding fuel, oil, coolant, lubricants, or battery electrolyte.

G. Disconnect the grounded negative battery connection to prevent accidental engine operation prior to attempting repairs or adjustments.

H. Make adjustments only when the engine is shut off. When necessary, make adjustment, then start engine to check adjustment. If not correct, shut off engine, readjust, then restart engine to recheck adjustment.

I. Keep hands, feet, floors, and controls clean and oil free to prevent slips and falls.

A. 6 HOT SURFACES, SHARP EDGES, AND SHARP CORNERS:

A. Avoid bodily contact with hot oil, hot coolant, hot surfaces, and sharp edges and corners.

B. Keep all parts of the body away from all points of air discharge and away from hot exhaust gases.

C. Wear personal protective equipment including gloves and head covering when working in, on, or around the compressor.

D. Keep a first aid kit handy. Seek medical assistance promptly in case of injury. Do not ignore small cuts and burns. They may lead to infection.

A.7 TOXIC AND IRRITATING SUBSTANCES:

A. Do not use air from this compressor for respiration except in full compliance with OSHA Standards 29 CFR 1910, and any other applicable Federal, State, or Local Codes or Regulations.

B. Operate the compressor only in open or well ventilated areas.

C. If the machine is operated indoors, discharge engine exhaust fumes outdoors.

D. Locate this compressor so that exhaust fumes are not apt to be carried towards personnel, air intakes servicing personnel areas, or towards the air intake of the compressor.

E. Fuels, oils, coolants, lubricants, and battery electrolyte used in this compressor are typical of the industry. Care should be taken to avoid accidental ingestion and skin contact. In the event of ingestion, seek medical treatment promptly. Do not induce vomiting if fuel is ingested. In the event of skin contact, wash with soap and water.

F. Wear an apron and a face shield or goggles when servicing the battery. Flush spillage of electrolyte on skin or clothing with large quantities of water.

A.8 ELECTRICAL SHOCK

A. Keep the towing vehicle, compressor, hoses, tools, and all personnel at least 10 feet from power lines and buried cables.

B. Keep all parts of the body and any hand held tools or other conductive objects away from exposed parts of the electrical system. Maintain dry footing, stand on insulated surfaces, and do not contact any other portion of the compressor, when making adjustments or repairs to exposed parts of the electrical system.

C. Attempt repairs only in clean, dry, well lighted and ventilated areas.

A.9 LIFTING

A. Lift only by bail provided.

B. Inspect lifting bail and points of attachment for cracked welds, cracked, bent, corroded or otherwise degraded members, or loose screws and nuts prior to lifting.

C. Make sure entire lifting rigging and supporting structure has been inspected, is in good condition, and has a rated capacity of at least 11,000 lb., (5,000 kg.).

D. Make sure lifting hook has a functional safety latch, or equivalent.

E. Use guide ropes or equivalent to prevent twisting or swinging.

F. Do not attempt to lift in high winds.

G. Keep all personnel out from under, and away from, the compressor when it is suspended.

H. Lift compressor no higher than necessary.

I. Set compressor down only on level surfaces capable of supporting at least 11,000 lb., (5,000 kg.).

J. Make sure parking brakes are set and block both front and rear of all four wheels prior to disengaging the lifting hook.

K. Keep lift operator in constant attendance whenever compressor is suspended.

A.10 ENTRAPMENT

A. Make sure all personnel are out of compressor before closing and latching any enclosure door.

A.11 JUMP STARTING

A. Observe all safety precautions mentioned elsewhere in this manual.

B. The batteries contain hydrogen gas which is flammable and explosive. Keep flames, spark and other sources away from the batteries.

C. The batteries contain acid which is corrosive. Do not allow battery acid to contact eyes, skin, fabrics, or painted surfaces, as serious personal injury or property damage could result. Flush any contacted areas thoroughly with water immediately. Wear an apron and face shield when attempting to jump start the compressor.

D. Remove all vent caps from both batteries in the compressor. Do not permit dirt or foreign matter to enter the open cells.

E. Check fluid level. If low, bring fluid to proper level before attempting to jump start.

F. Do not attempt to jump start if fluid is frozen or slushy. Bring batteries up to at least 40°F (4.4°C) before attempting to jump start.

G. Cover open cells of both compressor batteries with clean dampened cloths before attempting to jump start.

H. Attempt to jump start only with a vehicle having a 24 v. electrical system and NEGATIVE GROUND, that is equipped with a battery or batteries of comparable size.

I. Do not attempt to jump start with two 12 v. passenger car batteries connected in series. Both 12 v. batteries must have an ampere rating equivalent to or larger than that of the 24 v. batteries supplied with the machine.

J. Bring the starting vehicle alongside the compressor, but do not permit metal to metal contact between the compressor and the starting vehicle.

K. Set the parking brakes of both the compressor and the starting vehicle.

L. Place the starting vehicle in neutral or park, turn off all non-essential accessory electrical loads, and start its engine.

M. Use only jumper cables that are clean, in good condition, and are heavy enough to handle the starting current.

N. Avoid contact between jumper cable terminal clamp and any metalic portion of either the compressor or the starting vehicle, with the exception of the battery terminal that it is intended to be connected to.

O. Positive battery terminals are usually identified by a plus (+) sign on the terminal and the letters POS adjacent to the terminal. Negative battery terminals are usually identified by the letters NEG adjacent to the terminal.

P. Connect one end of a jumper cable to the positive (POS) (+) battery terminal in the starting vehicle. If the starting vehicle is provided with two (2) 12 v. batteries connected in series, connect the jumper cable to the positive (POS) (+) terminal of the ungrounded battery.

Q. Connect the other end of the same jumper cable to the positive (POS) (+) terminal of the ungrounded battery in the compressor.

R. Connect one end of a jumper cable to the grounded negative (NEG) terminal of the battery in the starting vehicle. If the starting vehicle is provided with two (2) 12 v. batteries connected in series, connect the jumper cable to the negative (NEG) terminal of the grounded battery.

S. Check your connection. Do not attempt to start the 24 v compressor with one 12 v. battery in the starting vehicle. Do not apply 24 v. to one 12 v. battery in the compressor.

T. Connect the other end of the jumper cable in Item P above, to the negative (NEG) terminal of the grounded battery in the compressor.

U. Start compressor in accordance with normal procedure. Avoid prolonged cranking. If necessary, check jumper cables, terminals, and batteries frequently for over-heating. If hot to the touch, wait for them to cool before attempting to start again.

V. Allow the compressor to warm up. When the compressor is warm and operating smoothly at normal idle RPM, disconnect jumper cables in reverse order to that outlined above.

W. Remove and carefully dispose of the dampened cloths, as they now may be contaminated with acid. Then replace all vent caps

WARRANTY

The Sullair compressor unit, if used in accordance with manufacturer's instructions, is warranted for two years against defects in materials and workmanship – and against loss of capacity due to wear. The unit will be replaced as a result of such defects.

The two year warranty extends only to the Sullair compressor unit. The driver, whether engine, electric motor or tubine, is covered by the original manufacturer's warranty. All other parts are warranted by Sullair for twelve months against defects in materials and workmanship.

ANY OTHER EXPRESSED OR IMPLIED WARRANTIES ARE EXCLUDED

This warranty does not apply to any unit damaged by accident, misuse or negligence. This warranty does not include liability for consequential damage.

All claims under this warranty should be made by contacting the Sullair distributor who sold the machine.

SULLAIR CORPORATION

MICHIGAN CITY, INDIANA 46360

Section 1
DESCRIPTION

1.1 INTRODUCTION

Your new Sullair 750 Quiet Portable Air Compressor will offer superior performance and reliability along with a minimal amount of maintenance requirements.

Your machine is equipped with a Sulliscrew™ rotary screw compressor unit. Compared to other compressors, the Sullair™ is unique in mechanical reliability, with virtually no wear or loss of performance. With Sullair compressors there is no inspection required of the working parts within the compressor unit.

As you continue reading this manual and come to learn how the machine operates and is cared for, you will see how surprisingly easy it is to keep a Sullair compressor in top operating condition.

1.2 DESCRIPTION OF COMPONENTS

Refer to Figures 1-1 and 1-2. The components and assemblies of the Sullair 750 Quiet Air Compressor are clearly shown.

The package includes a compressor unit, diesel engine, compressor inlet system, compressor cooling, lubrication system, compressor discharge system, capacity control system and instrument panel and electrical system. The 750 Quiet is also supplied sound deadening insulation to lower noise emissions to a comfortable level.

The Sulliscrew™ Compressor Unit is driven by an industrial engine designed to provide enough horsepower for more than adequate reserve at rated conditions. Refer to the Engine Operators Manual for a more detailed description of the engine.

The engine cooling system is comprised of a radiator, high capacity fan, engine oil cooler and thermostats. The high capacity fan pushes air through the radiator, keeping the engine at the proper operating temperature.

The same fan used to cool the engine water cools the oil used in the compressor cooling and lubrication system. Prior to passing through the radiator the fan air also passes through the compressor oil cooler which is mounted adjacent to the radiator. As the air passes through the cooler, the heat of compression is removed from the oil.

The engine is coupled to the compressor unit with a nonlubricated ring gear and plate type coupling. The 750 is supplied with a fuel tank large enough to keep the machine running at full load through one eight hour shift.

Figure 1-1 Sullair 750 Rotary Screw Portable Air Compressor

1. ENGINE AIR FILTER
2. PRESSURE RELIEF VALVE
3. COMPRESSOR OIL LEVEL GAUGE
4. MAIN OIL FILTER
5. RADIATOR
6. OIL COOLER (HIDDEN)
7. COMPRESSOR AIR FILTER
8. FUEL OIL LEVEL GAUGE
9. FUEL FILLER
10. COMPRESSOR UNIT
11. BATTERIES

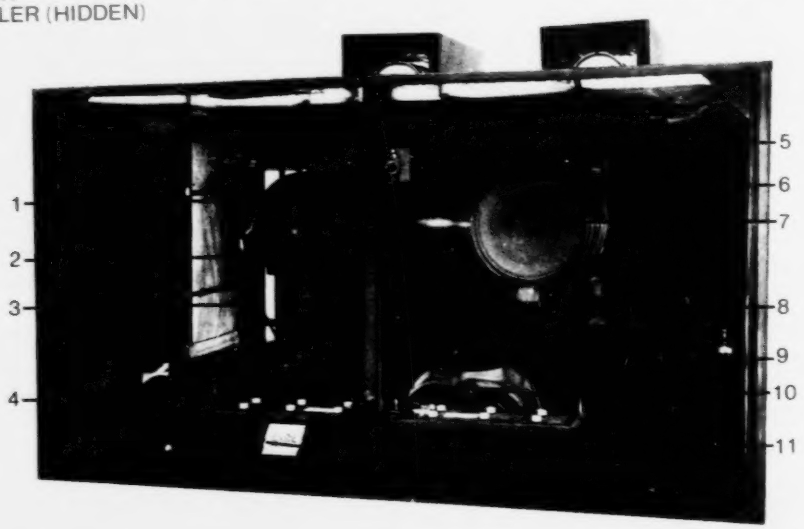
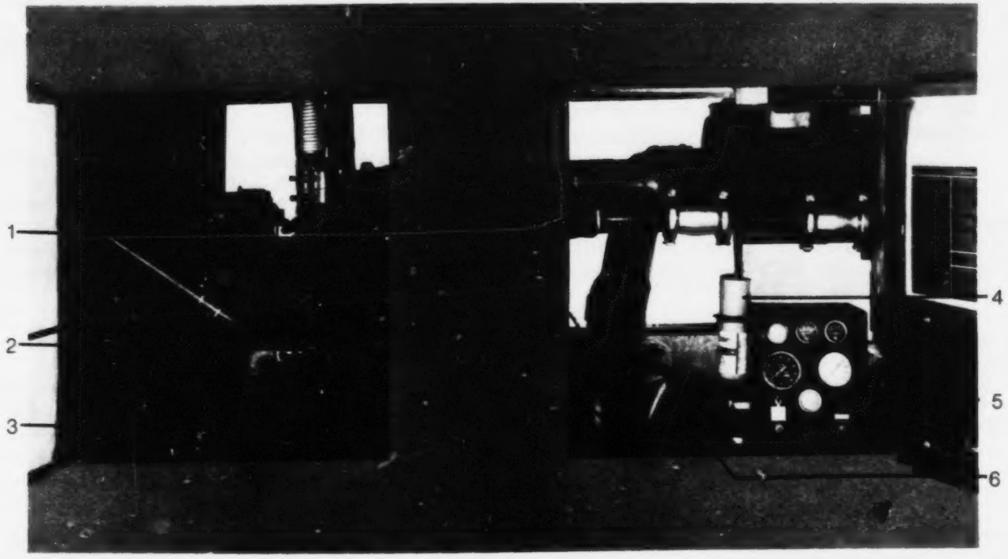


Figure 1-2 Sullair 750 Rotary Screw Portable Air Compressor

1. ENGINE
2. COMPRESSOR OIL FILLER
3. THERMAL VALVE
4. ETHER START KIT
5. INSTRUMENT PANEL
6. PRESSURE REGULATOR



1.3 SULLISCREW™ COMPRESSOR UNIT, FUNCTIONAL DESCRIPTION

Sullair compressors feature the Sulliscrew™ compressor unit, a single stage, positive displacement, flood lubricated type compressor. This unit provides continuous pulse free compression to meet your needs. With a Sullair machine no maintenance or internal inspection of the compressor unit is required.

Oil is injected into the compressor unit and mixes directly with the air as the rotors turn compressing the air.

The oil flow has three primary functions:

- As a coolant, it controls the rise of air temperature normally associated with the heat of compression.
- Seals the leakage paths between the rotors and the stator and also between the rotors themselves.
- Acts as a lubricating film between the rotors allowing one rotor to directly drive the other, which is an idler.

After the air/oil mixture is discharged from the compressor unit, the oil is separated from the air. At this time, the air flows to your service line and the oil is cooled in preparation for reinjection.

1.4 COMPRESSOR COOLING AND LUBRICATION SYSTEM, FUNCTIONAL DESCRIPTION

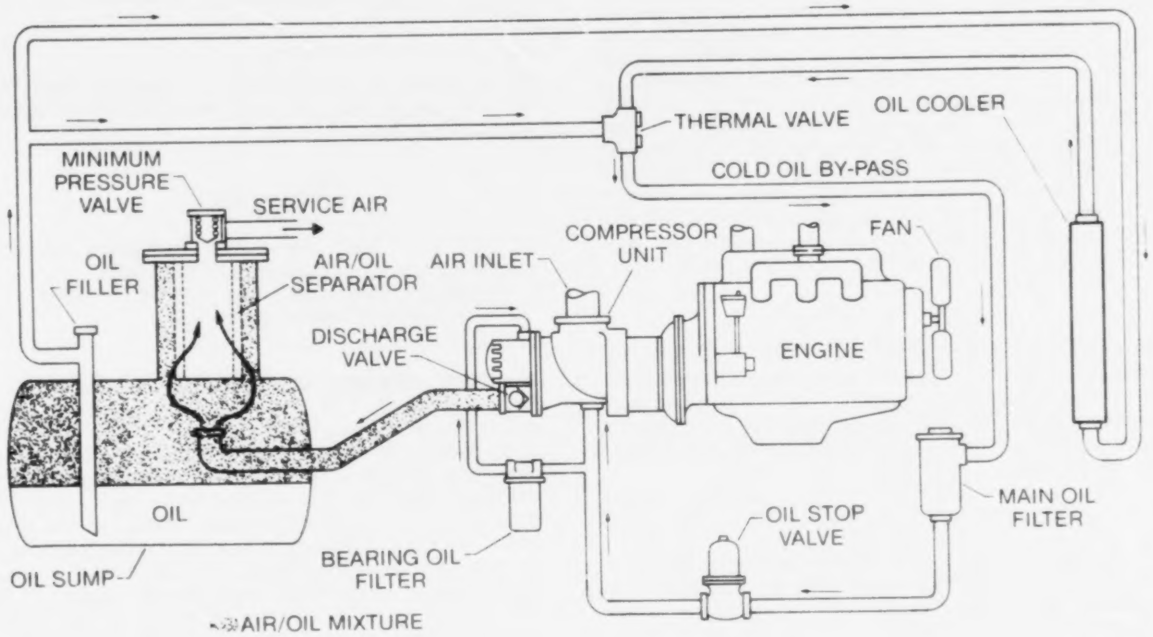
Refer to Figure 1-3. The Compressor Cooling and Lubrication System is designed to provide adequate lubrication as well as maintain the proper operating temperature of your machine. In addition to a cooler and fan, the system consists of a main filter, thermal valve, bearing oil filter, and oil-stop valve.

Oil is used in the system as a coolant and a lubricant. The oil is housed in the receiver/sump which from this time forward will be referred to as the sump. Upon start-up, the temperature of the oil is cool and routing to the oil cooler is not necessary. The oil, taking the path of least resistance, flows to the thermal valve.

The thermal valve has two entrance ports and one exit port. The entrance ports will be referred to as Port A and Port B. Port A accepts oil from the sump and Port B accepts oil from the cooler.

As previously stated, upon start-up the oil temperature is cool and routing to the cooler is not required. The oil first enters the thermal valve and then flows on to the compressor unit, bypassing the cooler. As the compressor continues to operate, the temperature of the oil rises and Port A of the thermal valve begins

Figure 1-3 Compressor Cooling and Lubrication System



to close. The closing of Port A forces a portion of the oil through the oil cooler. The cooler is a radiator type cooler that works in conjunction with the engine fan. The fan forces air through the cooler removing the heat of compression from the oil. From the cooler the oil is routed back to the thermal valve, entering at Port B. Before the temperature of the oil becomes high enough that Port A is completely closed, cooled oil entering at Port B is mixed with warmer oil entering at Port A. When the temperature of the oil reaches 140°, Port A is completely closed causing all oil to flow to the cooler. After the oil passes through the thermal valve it is then directed through the main oil filter. There the oil is filtered in preparation for injection into the compression chamber and bearings of the compressor unit. The filter has a replaceable element and a built-in bypass valve which allows the oil to flow even when the filter element becomes plugged and requires changing or when the viscosity of the oil is too high for adequate flow. After the oil is properly filtered, it then flows through the oil stop valve and on to the compressor unit where it lubricates, seals and cools the compression chamber as well as lubricating the bearings and gears. The oil stop valve functions on shutdown when it shuts off the oil supply to the compressor unit. The oil stop valve is held open by a pressure signal from the compressor unit. At shutdown, the pressure signal is lost and the oil stop valve closes isolating the compressor unit from the cooling system.

A portion of the oil flowing to the compressor unit is routed to a bearing oil filter. All oil flowing to the gears, shaft seal, and the internal bearings of the compressor unit flows through this extra fine filter insuring the cleanest possible oil for these components. This filter also has a built-in bypass valve and a replaceable element.

1.5 COMPRESSOR DISCHARGE SYSTEM, FUNCTIONAL DESCRIPTION

Refer to Figure 1-4. The Sulliscrew™ compressor unit discharges compressed air/oil mixture through a discharge check valve into the sump. The discharge valve is located on the rear of the compressor unit at the end opposite the drive shaft. The discharge check valve prevents discharged air from returning to the compression chamber after shutdown.

From the discharge valve the air/oil mixture is directed to the combination sump. The sump has three functions.

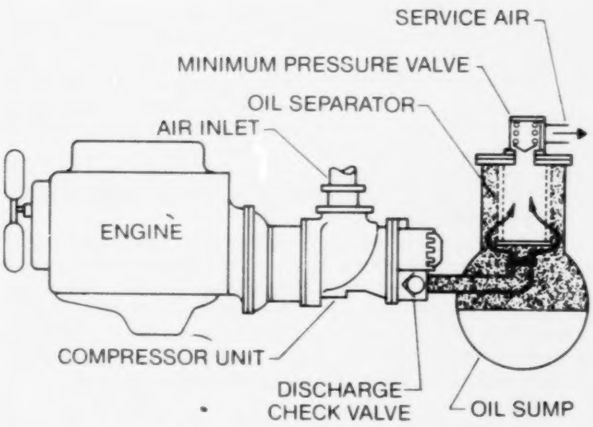
- It acts as a primary oil separator.
- Serves as the compressor oil sump.
- Houses the final oil separator.

The compressed air/oil mixture enters the sump and is directed against the side wall. By change of direction and reduction of velocity, larger droplets of oil fall to the bottom of the sump. The small percent of oil remaining in the compressed air collects on the surface of the final separator element as the compressed air flows through the separator. As more and more oil collects in the element surface, the oil descends to the bottom of the separator. A return line (or scavenge tube) leads from the bottom of the separator element to the inlet region of the compressor unit. Oil collecting on the bottom of the separator element is returned to the compressor by the pressure difference between the area surrounding the separator element and the compressor inlet. An orifice (protected by a strainer) is included in this return line to assure proper flow.

The sump is ASME code rated at 150 PSIG working pressure. A minimum pressure valve, located downstream from the separator, assures a minimum receiver pressure of 40 PSIG during all conditions. This pressure is necessary for proper air/ oil separation and proper oil circulation.

A check valve at the outlet of the receiver is installed to prevent compressed air in the service line from bleeding back into the receiver on shutdown when the compressor is being run in parallel with other compressors tied to a large air system. The check valve is also necessary when the compressor is functioning with a pressure pot sand blasting operation.

Figure 1-4 Compressor Discharge System



A pressure relief valve (located on the wet side of the separator) is set to open if the sump pressure exceeds 140 PSIG. A temperature switch will shutdown the compressor if the discharge temperature reaches 240°F (115°C).

Oil is added to the sump via a capped oil filler. An oil level gauge glass enables the operator to visually monitor the sump oil level.

CAUTION

> DO NOT open the oil filler cap when the machine is pressurized. Shut down the machine and bleed the receiver to zero PSIG before removing the cap.

1.6 CONTROL SYSTEM, FUNCTIONAL DESCRIPTION

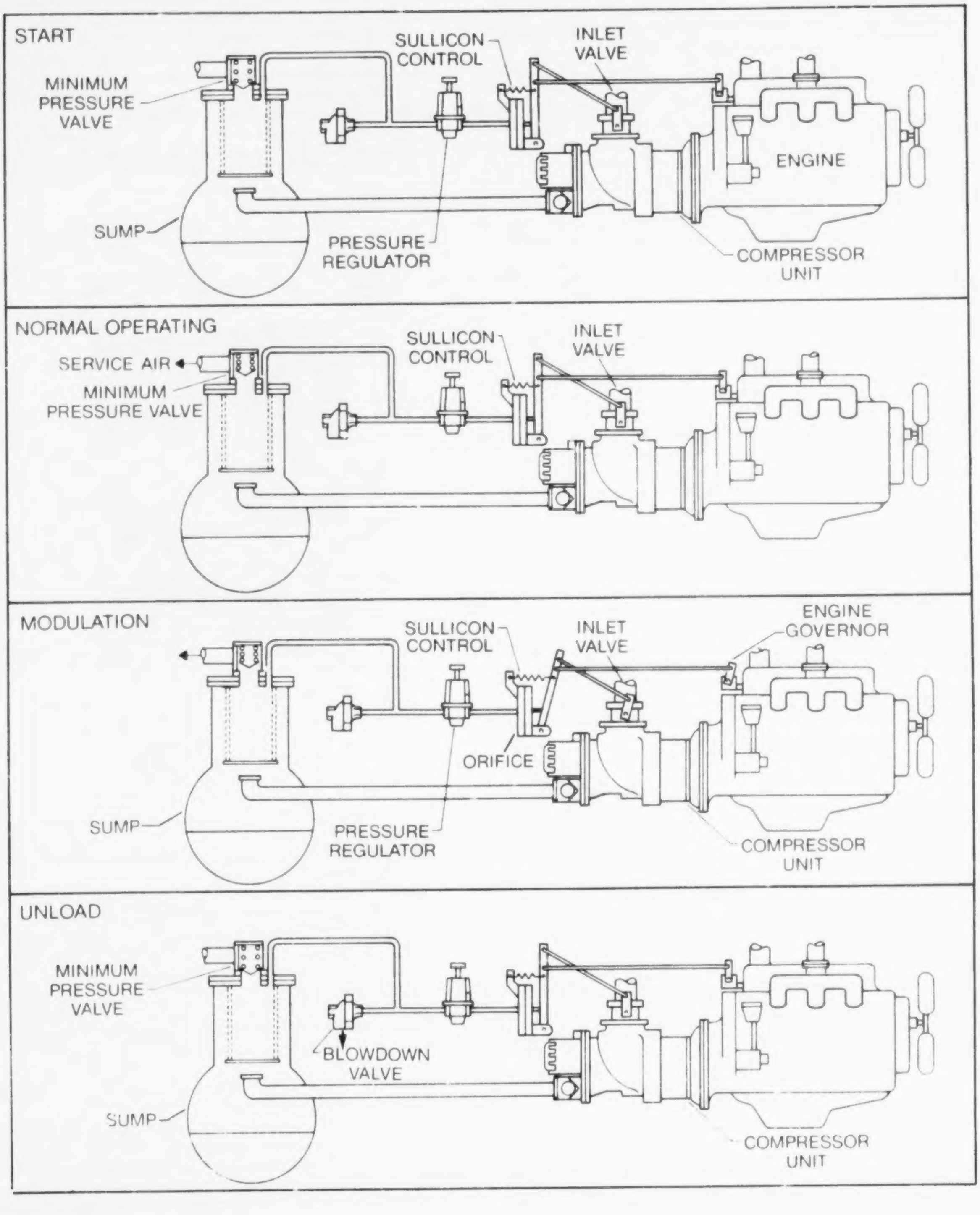
Refer to Figure 1-5. The purpose of the control system is to regulate the amount of air intake in accordance with the amount of compressed air being used. The control system consists of a Sullicon Control, pressure regulating valve, blowdown valve and link rods which connect the Sullicon Control to the inlet valve and engine governor. The functional description of the control system is described below in 4 distinct phases of operation. This description will apply to all 750 control systems with the exception of the stated pressures which may vary depending on your pressure requirements. The pressures stated will be in accordance with a machine having an operating pressure range of 100-110 PSIG.

START – 0 TO 40 PSIG
When the compressor is started the sump pressure will quickly rise from 0 to 40 PSIG. During this period the pressure regulator valve and the Sullicon Control are inoperative. The spring on the Sullicon Control holds the butterfly valve fully open and the compressor operates at full rated capacity. As the compressor operates at full capacity, the engine runs at full speed. The rising sump pressure is isolated from the service line by the minimum pressure valve which is set at approximately 40 PSIG.

NORMAL OPERATION – 40 TO 100 PSIG
When the sump pressure rises above 40 PSIG, the minimum pressure valve opens and delivers compressed air to your service line. At this time, the Sullicon Control remains inoperative, holding the inlet valve fully open for maximum air output. The engine will continue to run at full speed during this phase of operation.

MODULATION – 100 TO 110 PSIG
Should less than the rated capacity of air be used, the service line pressure will rise above 100 PSIG. The pressure regulating valve gradually opens, applying pressure to the diaphragms on the Sullicon Control.

Figure 1-5 Control System


START
SULLICON CONTROL
INLET VALVE
MINIMUM PRESSURE VALVE
ENGINE
SUMP
PRESSURE REGULATOR
COMPRESSOR UNIT
NORMAL OPERATING
SULLICON CONTROL
INLET VALVE
SERVICE AIR
MINIMUM PRESSURE VALVE
MODULATION
SULLICON CONTROL
INLET VALVE
ENGINE GOVERNOR
ORIFICE
SUMP
PRESSURE REGULATOR
COMPRESSOR UNIT
UNLOAD
MINIMUM PRESSURE VALVE
BLOWDOWN VALVE
SUMP
COMPRESSOR UNIT

This causes the Sullicon Control to partially close the inlet valve and reduce the speed of the engine. As the pressure increases, the Sullicon Control will further close the inlet valve and continue reducing the engine speed until it reaches loaded speed.

The Sullicon Control has an orifice in its cover which vents a small amount of air to the atmosphere when the pressure regulating valve is open. This allows the Sullicon Control to vary air output matching air demand. The orifice also bleeds any accumulated moisture from the Sullicon Control. The compressor will continue to run in this manner until air demand increases. As air demand increases, the sump pressure will fall below 100 PSIG. The pressure regulating valve will close, the air inlet valve will be fully open and the engine will once again run at full speed.

SHUTDOWN
The blowdown valve is held closed by a pressure signal from the compressor unit. Upon shutdown the pressure signal is lost and the blowdown valve opens venting sump pressure to the atmosphere.

1.7 AIR INLET SYSTEM, FUNCTIONAL DESCRIPTION

Refer to Figure 1-6. The compressor inlet system consists of air filters, restriction indicators, compressor air inlet valve and interconnecting piping to the engine and compressor.

The air filters are 3 stage dry element type filters. These filters are capable of cleaning extremely dirty air; however, in such cases more frequent checks of the air filter restriction indicators will be required. The air filter restriction indicator (located on the rear of each air filter) will show a red signal when restriction of the air passing through the filter becomes too high. At this time, clean or change the air filter element. See Section 4 for air filter maintenance procedures. The indicator should be checked daily, after start-up under normal conditions.

The compressor air inlet valve controls the amount of air intake of the compressor in response to the operation of the Sullicon Control.

Figure 1-6 Air Inlet System

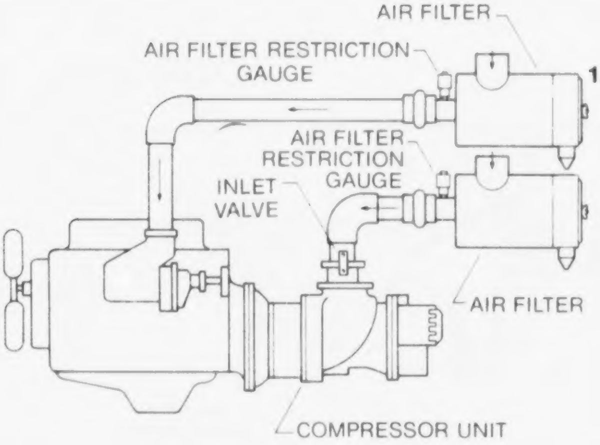
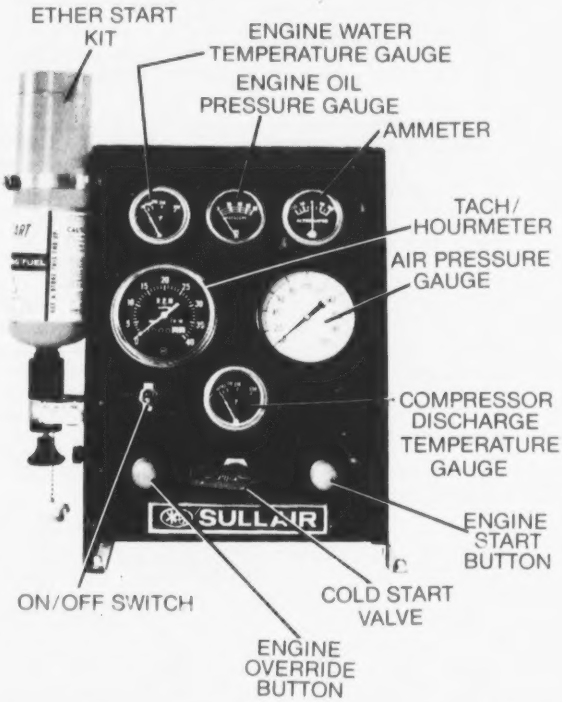

AIR FILTER
AIR FILTER RESTRICTION GAUGE
AIR FILTER RESTRICTION GAUGE
INLET VALVE
AIR FILTER
COMPRESSOR UNIT

Figure 1-7 Instrument Panel Group


ETHER START KIT
ENGINE WATER TEMPERATURE GAUGE
ENGINE OIL PRESSURE GAUGE
AMMETER
TACH/ HOURMETER
AIR PRESSURE GAUGE
COMPRESSOR DISCHARGE TEMPERATURE GAUGE
ENGINE START BUTTON
SULLAIR
ON/OFF SWITCH
COLD START VALVE
ENGINE OVERRIDE BUTTON

1.8 INSTRUMENT PANEL GROUP, FUNCTIONAL DESCRIPTION

Refer to Figure 1-7. The Instrument Panel Group consists of a panel containing an engine water temperature gauge, engine oil pressure gauge, air pressure gauge, compressor discharge temperature gauge, ammeter, tach-hourmeter, on/off switch, starter switch, circuit override switch, emergency stop lever which is located on the outside of the canopy just below the instrument panel window, a cold start valve, fuse and ether starting aid kit.

Refer to Figure 1-7 for locations of the following indicators and controls:

- The engine water temperature gauge is connected to the engine at an access port which allows it to sense the temperature of the engine's cooling water. This gauge continually monitors the temperature of the cooling water during operation. The normal reading should be approximately 160° - 210°F (71-104°C).

- The engine oil pressure gauge monitors the engine oil pressure from the moment the machine is started. It is essential that the proper oil pressure be maintained. The proper oil pressure reading should be approximately 40-60 PSI at 1050 RPM.
- The air pressure gauge continually monitors the sump pressure at various load and/or unload conditions.
- The ammeter indicates the performance of the electrical charging system. Upon starting the engine, the needle should move to the positive (+) side of the zero (0); however, the needle should fall back to a position slightly past the zero on the plus side after the engine starts. The ammeter should never indicate a reading on the negative (–) side of zero, as this indicates that the alternator is not charging.
- The compressor discharge temperature gauge monitors the temperature of the air/oil mixture leaving the compressor unit. The normal reading should be approximately 180°F (82°C).
- The tach-hourmeter indicates the engine speed as well as accumulative hours of compressor operation. This is useful for planning and logging service operations.
- The on-off switch is used to energize the machine's electrical system and is placed in the off position to shut the machine down. This switch must be in the on position before the engine can be started.
- The starter switch is depressed when starting the compressor and must be released as soon as the engine starts running.
- The circuit override switch is depressed at the same time the starter button is depressed. This switch allows the electrical circuit to bypass the engine oil pressure switch when starting. Without this switch the engine could not be started, as no oil pressure is present until the engine is running.
- The cold start valve is provided for cold weather starting. When placed in the start position, the cold start valve will apply pressure to the Sullicon Control causing the inlet valve to partially close. This will allow the engine to run at unload speed (lower pressure) until the engine is properly warmed up, at which time the valve is to be placed in the run position.

- The ether starting aid kit is used to assist in engine starting. This kit is especially useful in cold weather operation.

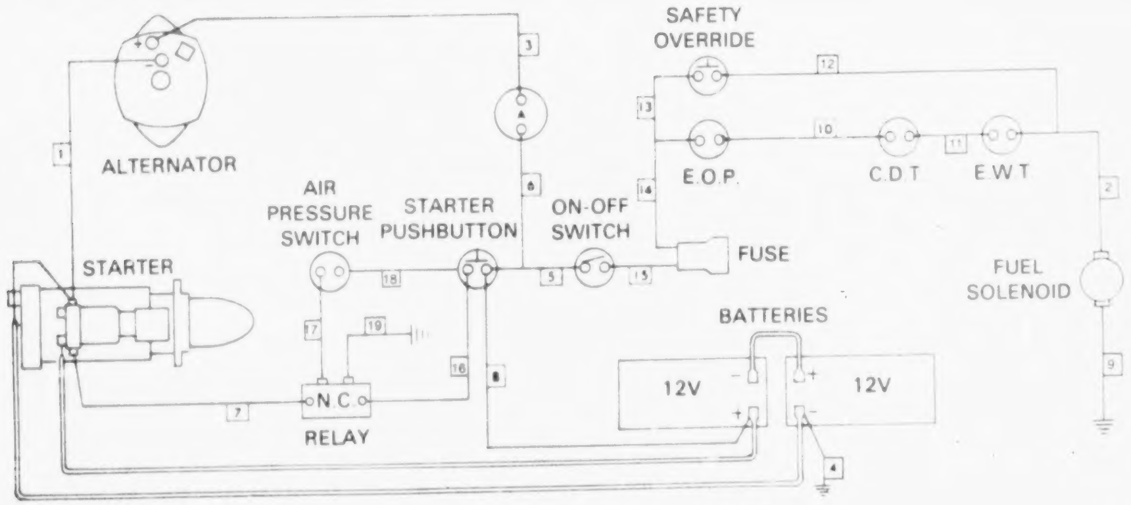
- The emergency stop lever allows the operator to quickly shut down the machine in case of emergency. When the lever is pulled the machine will immediately shutdown. The engine air intake must be manually reset.

EMERGENCY STOPPING
If the engine does not stop after using the normal stopping procedure, pull the "Emergency Stop" lever all the way out. This control cuts off the air to the engine. Do not try to restart again until the cause for the malfunction has been found and corrected.

IMPORTANT

The emergency shut-down system should never be used except in an emergency. Use of the emergency shut-down can cause oil to be sucked past the oil seals and into the blower housing.

Figure 1-8 Electrical System



E.O.P. - ENGINE OIL PRESSURE
E.W.T. - ENGINE WATER PRESSURE
C.D.T. SWITCH - COMPRESSOR DISCHARGE TEMPERATURE

The air shut-off valve, located on the blower air inlet housing, must be reset by hand and the "Emergency Stop" lever pushed in before the engine is ready to start again.

1.9 ELECTRICAL SYSTEM, FUNCTIONAL DESCRIPTION

Refer to Figure 1-8. The electrical system is comprised of not only the necessary equipment required to operate the compressor, but also a system is included to shutdown the machine in the event of a malfunction. The components of the electrical system are an engine starter with an integral solenoid, two batteries, an alternator with a built-in voltage regulator, a fuel rack solenoid with a special slow blow fuse, a compressor discharge temperature switch (which will shutdown the machine should the compressor temperature exceed 240°F or 115°C), an engine water temperature switch (set to shutdown the machine when water temperature reaches 210°F (99°C) and an engine oil pressure switch. The engine oil pressure switch is provided to shutdown the machine when the engine oil pressure becomes insufficient. Upon start-up, it is necessary to override or bypass the engine oil pressure switch (by pressing the override button on the instrument panel) until the oil pressure throughout the system is high enough to close the switch and complete the circuit to the fuel rack solenoid.

Section 1
DESCRIPTION

SPECIFICATIONS

DIMENSIONAL:

Model Series	**Length*****		**Width**		**Height***		**Weight****	
	in	mm	**in**	mm	**in**	mm	**lb**	kg
750 GPQ-4 Wheel	**181.5**	4610	**90**	2286	**109.5**	2781	**9600**	4355

* Height over Mufflers
** Dry Weight - Wet Weight is 11,000 lb. (5,000 kg.)
*** Length Including Drawbar

COMPRESSOR:

Type	Rotary Screw
Maximum Operating Pressure	125 PSIG (862KPa)
Delivery @ 100 PSIG	750 Free CFM (21 M^3/min.)
Cooling	Pressurized Oil
Lubricating Oil	See Table 1
Sump Capacity	30 Gallons (112 Liters)
Track Width	68" (1727 mm)
Tire Size (Load Range)	7.50 x 16 LT Load Range D
Tire Pressure	45 PSIG (379 KPa)
Wheel Bolt Torque	80-90 ft/lbs.
Wheel Size	16 x 5.50
Operating Tilt (Max.)	15 Degrees
Electrical System	24 Volt
Battery	Amp/Hr @ 20 Hr Rate
Alternator	65 Amp.

ENGINE:

Make	6v-71 Detroit Diesel
Type	Diesel
Rated Speed	2100 RPM
Idle Speed	1050 RPM
Horsepower @ 85°F/500 ft. alt	228 (170 Kw)
Cylinders	6
Cycles	2
Bore and Stroke	4.25 x 5 (108 x 127mm)
Displacement	426 cu. in. (6.98 Liters)
Lubricating System	Full Pressure Oil
Crankcase Capacity	6.5 gals. (24 Liters)
Type Motor Oil	See Table 2
Radiator Capacity	17 Gallons (64 Liters)
Fuel Tank Capacity	110 Gallons (416 Liters)
Compression Ratio	18.7:1
Fan Belt Tension	60-80 Lbs (27-36 Kg)
Alternator Belt Tension	50-70 lbs (23-32 Kg)

Section 2
SPECIFICATIONS

LUBRICATION GUIDE—COMPRESSOR

Compressor oil should conform to the following specifications:

Table 1

Ambient Temp.	10° – 90° F	Above 90° F
500 HR "Normal" Oil change period.	MIL-L-2104B (API CC) API SE, CD SAE 10W Dexron II ATF D-A Torque Fluid	MIL-L-2104B (API CC) API SE, CD SAE 20W, 20 Dexron II ATF D-A Torque Fluid
250 HR "Normal" oil change period.	Non-Detergent* Mineral Oil 150 SSU at 100°F	Non-Detergent* Mineral Oil 300 SSU at 100°F

*Must contain rust, oxidation, and foam inhibitors and exhibit good water separation characteristics.

APPLICATION GUIDE

Heavy-Duty, High Temperature, conditions, where severe oil oxidation can occur within 200-300 hours of operation, detergent motor oils or automatic transmission fluids (ATF) are preferred.

For light-duty, high-humidity service where condensed moisture and emulsification (mayonnaise) may occur, a non-detergent oil with R & O and foam inhibitors and good water separation characteristics is preferred. Water must be drained from receiver.

Do not mix types of oils. Contamination of non-detergent mineral oils with traces of ATF or detergent motor oils may lead to operational problems such as foaming, filter plugging, orifice or line plugging.

When ambient conditions exceed those noted or if conditions warrant use of extended life lubricants, contact Sullair for recommendation.

Sullair encourages the user to participate in an oil analysis program with the oil supplier. This could result in an oil change interval differing from that stated in the manual.

LUBRICATION GUIDE—ENGINE

For engine oil specifications refer to the engine operators manual.

Section 3
OPERATION

3.1 GENERAL

While Sullair had built into its compressor a comprehensive array of controls and indicators to assure you that it is running properly, you will want to recognize and interpret the readings which will call for service or indicate the beginning of a malfunction. Before starting your Sullair compressor, read this section thoroughly; familiarize yourself with the controls and indicators, their purpose, location, and use.

3.2 PURPOSE OF CONTROLS

Control or Indicator	*Purpose*
ON/OFF SWITCH	Turn this switch to the on position to energize the electrical system of the machine. This switch is located on the instrument panel.
ENGINE STARTER SWITCH	Depress to start the engine. This switch is located on the instrument panel.
OVERRIDE SWITCH	Located on the instrument panel, used to bypass the oil pressure switch when starting the engine.
AMMETER	Monitors the performance of the engine alternator and is the primary indicator of an electrical malfunction. The normal reading is slightly past "0" on the + side.
AIR PRESSURE GAUGE	Continually monitors the pressure inside the receiver sump at various load and unloaded conditions.
ENGINE WATER TEMPERATURE GAUGE	Monitors the temperature of the engine water. The normal operating temperature should read approximately 160°-185°F (71-85°C).
TACH-HOURMETER	Indicates the engine speed as well as accumulated hours of operation. Useful for planning and logging service schedules.
ENGINE OIL PRESSURE GAUGE	Monitors the engine oil pressure. The normal reading is 40-60 PSIG @ 1050 RPM.
COMPRESSOR DISCHARGE TEMPERATURE GAUGE	Monitors the temperature of the air/oil mixture leaving the compressor unit. The normal reading should be approximately 180°F (82°C).

3.2 PURPOSE OF CONTROLS (continued)

Control or Indicator	*Purpose*
OIL LEVEL LEVEL GAUGE	Monitors the oil level in the sump. Proper level is always visible in the sight glass. Check the level when the machine is shutdown.
COMPRESSOR DISCHARGE TEMPERATURE SWITCH	Opens the electrical circuit to shut down the machine when the discharge temperature reaches 240°F (115°C).
DISCHARGE CHECK VALVE	Cuts off reverse flow of air/oil mixture through compressor discharge system at compressor shutdown.
THERMAL VALVE	Regulates flow of fluid to and around the oil cooler. Designed to maintain a minimum operating temperature; used for fast warmup at startup and to eliminate condensation during operation.
OIL STOP VALVE	Cuts off flow of fluid to the compressor unit at machine shutdown, and allows flow of oil to the unit on startup.
MINIMUM PRESSURE VALVE	Maintains minimum of 40 PSIG in compressor sump. This valve restricts receiver air discharge from receiver/sump when pressure falls to 40 PSIG, however, full flow is allowed at normal operating pressures.
PRESSURE RELIEF VALVE	Opens sump pressure to the atmosphere should pressure inside the sump pressure exceed 140 PSIG.
SULLICON CONTROL	Regulates the amount of air allowed to enter the air inlet valve. This regulation is determined by the amount of air being used at the service line.
PRESSURE REGULATOR	Opens a pressure line between the sump and Sullicon Control allowing Sullicon Control to regulate air delivery according to air demand.
BLOWDOWN VALVE	Vents sump pressure to the atmosphere at shutdown.
TERMINAL CHECK VALVE	Prevents air backflow into the sump after shutdown.
EMERGENCY STOP LEVER	Allows the operator to quickly shut down the machine in case of emergency. When the lever is pulled the machine will immediately shutdown. This control cuts off the air to the engine. Do not try to restart again until the cause for the malfunction has been found and corrected.

3.2 PURPOSE OF CONTROLS (continued)

Control or Indicator	*Purpose*
EMERGENCY STOP LEVER (continued)	**IMPORTANT** The emergency shut-down system should never be used except in an emergency. Use of the emergency shut-down can cause oil to be sucked past the oil seals and into the blower housing. The air shut-off valve, located on the blower air inlet housing, must be reset by hand and the "Emergency Stop" lever pushed in before the engine is ready to start again.
COLD START VALVE	Used for cold weather starting, allows the engine to run at unload speed (lower pressure) until properly warmed up.

3.3 INITIAL STARTUP PROCEDURE

The following procedure should be used to make the initial startup of your compressor.

1. Position the machine on a level surface so that proper amounts of liquid can be added.
2. Add a water and anti-freeze solution to the engine radiator. Engine cooling system capacity is 17 gallons. (643 liters).
3. Fill compressor oil sump with oil as recommended in Section 2, Specifications. System capacity is 30 gallons. (112 liters).
4. Check engine oil level and add if necessary.
5. Fill the fuel tank.
6. Fill the battery with electrolyte.
7. Crack open one service line.
8. Turn the cold start valve to the start position.
9. Turn the on-off switch to the on position.
10. Push the starter and override buttons in simultaneously.
11. If necessary use the ether starting aid to assist in starting.
12. Release the starter button as soon as the engine fires and release the override button when oil pressure reaches 20 PSIG.
13. When the engine water temperature reaches 130°F (54°C), move the cold start valve to the run position and the machine is ready for use.
14. After the initial run, shut the machine down and refill the radiator and compressor oil sump as required. Tighten any loose fittings and check fan belt tension.

3.4 SUBSEQUENT STARTUP PROCEDURE

On subsequent starts follow the procedure explained below.

1. Check engine oil, water and fuel gauges.
2. Check compressor oil level.
3. Turn the on-off switch to the on position.
4. Simultaneously push the starter and override buttons.
5. If necessary use the ether starting aid to assist in starting.
6. Release the starter button as soon as the engine fires and release the override button when oil pressure reaches 20 PSIG.
7. When the engine water temperature reaches 130°F (54°C), the machine is ready for use.

3.5 SHUTDOWN PROCEDURE

To shutdown the machine, close the service valves and run machine for approximately 5 minutes; then turn the on-off switch to the off position.

4.1 GENERAL

A good maintenance program is the key to long machine life. Below is a program that when adhered to should keep your machine in top running condition. Routine maintenance operations required for the engine are not covered in this schedule. For engine maintenance requirements other than stated below, refer to the Engine Manual where a more detailed description of service instructions is given. See Section 4.9, Parts Replacement and Adjustment Procedures for detailed description of specific compressor system components.

4.2 DAILY OPERATION

Prior to starting your machine, it is necessary to check the oil level in the sump. Should the level be low, simply add the necessary amount. If the addition of oil becomes too frequent, a simple problem has developed which is causing this excessive loss. See the Troubleshooting Section (4.10) under excessive oil consumption for a probable cause and remedy. Also check the engine oil level and the radiator coolant level prior to starting.

NOTE

The radiator and engine cooling system must be drained and flushed every two years. Replace the coolant with a solution of 50% permanent anti-freeze and 50% water. Do not use a leak sealing type of anti-freeze. Should a 100% water solution be used, a non-chromate rust inhibitor must be added.

After a routine start has been made, observe the instrument panel gauges and be sure they monitor the correct readings for that particular phase of operation. After the machine has warmed up, it is recommended that a general check on the overall machine and instrument panel be made to assure that the compressor is running properly. Also check the air filter maintenance indicator. Should the indicator show a red signal, wash or replace the element immediately. (See Air Filter Maintenance in Section 4.9).

4.3 MAINTENANCE AFTER INITIAL 50 HOURS OF OPERATION

After the initial 50 hours of operation a few maintenance requirements are needed to rid the system of any foreign materials which may have accumulated during machine assembly. Perform the following maintenance operations to prevent unnecessary problems:

1. Clean return line orifice.
2. Clean compressor unit gear housing, bearing and shaft seal orifices.

4.4 MAINTENANCE EVERY 100 HOURS

After every 100 hours of operation, it will be necessary to perform the following:

1. Check the battery level and fill with water if necessary.
2. Change the engine oil and oil filter. This is best done when the engine is hot.

4.5 MAINTENANCE EVERY 200 HOURS

Perform the following after every 200 hours of operation:

1. Change the fuel filter. Should persistant clogging be evident, change the fuel filter more frequently.
2. Check fan belt tension.
3. Clean the radiator and cooler exterior. Depending on how contaminated the atmosphere may be, more frequent cooler and radiator cleaning may be necessary.

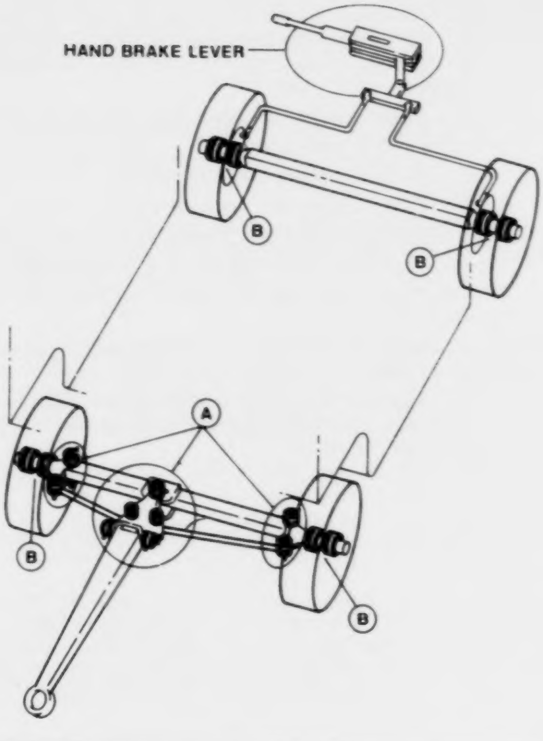
4.6 MAINTENANCE EVERY 500 HOURS

1. Change the compressor oil, clean the main oil filter and replace the bearing oil filter element. Run the machine for 5-10 minutes to warm the oil and drain the oil sump by removing the plug at the bottom of the sump. For oil filter element replacement, see Section 4.8 and 4.9, Servicing the Oil Filters. Fill the sump with oil according to specifications in Section 2. Remove any accumulated dirt from the oil filler cap prior to filling the sump.
2. Lubricate the control linkage.

4.7 MAINTENANCE EVERY 1000 HOURS

1. Clean the return line orifice.
2. Repack the wheel bearings on wheel mounted units.

Figure 4-1 Running Gear Lubrication



..8 RUNNING GEAR LUBRICATION

Refer to Figure 4-1.

An inspection of the running gear should be made on a routine basis. A schedule should be made so that the pivot points of the running gear are inspected every 30 days(the pivot points are marked A in Figure 4-1). When necessary lubricate with a grease conforming to military grease specification Mil-F-3541.

The wheel bearings must be inspected every 90 days (the wheel bearings are marked B in Figure 4-1.) When necessary pack the wheel bearings with a grease conforming to military specification number Mil-G-10924.

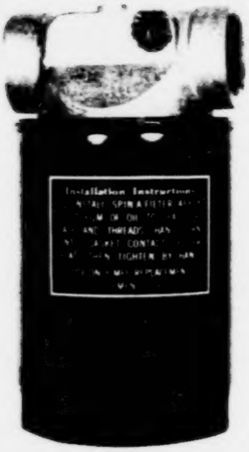
The hand brake lever should be lubricated every 30 days with an oil conforming to military specification Mil-L-7870.

4.9 BEARING FILTER ELEMENT REPLACEMENT

Refer to Figure 4-2.

1. Using a strap wrench, remove the old element and gasket.
2. Clean gasket seating surface.
3. Apply a light film of oil to the new gasket.
4. Hand tighten new element until new gasket is seated in the gasket groove.
5. Continue tightening element by hand an additional 1/2 to 3/4 turn.
6. Restart machine and check for leaks.

Figure 4-2 Bearing Filter

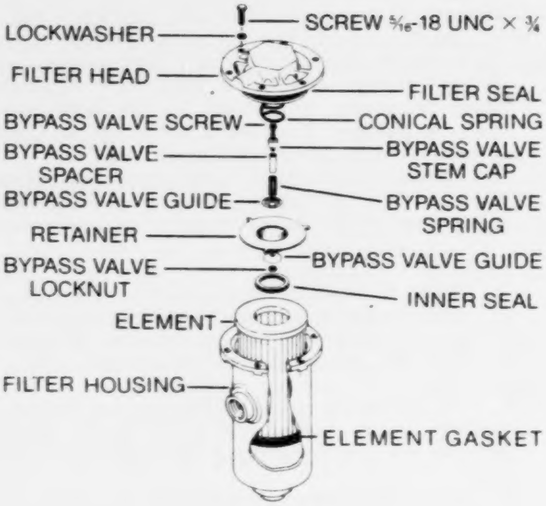

Installation Instructions

4.10 SERVICING THE MAIN OIL FILTER

Refer to Figure 4-3. The main oil filter is located schematically in the oil line between the sump and the compressor unit. Two service kits are required for complete servicing:

1. Gasket Kit, 46430. Use to replace filter gaskets only when cleaning the element. Parts shown on Figure 4-1 as (**).

Figure 4-3 Main Filter


LOCKWASHER
SCREW 5/16-18 UNC × 3/4
FILTER HEAD
FILTER SEAL
BYPASS VALVE SCREW
CONICAL SPRING
BYPASS VALVE SPACER
BYPASS VALVE STEM CAP
BYPASS VALVE GUIDE
BYPASS VALVE SPRING
RETAINER
BYPASS VALVE GUIDE
BYPASS VALVE LOCKNUT
INNER SEAL
ELEMENT
FILTER HOUSING
ELEMENT GASKET

2. Element Kit, 46428. Use to replace a damaged or worn filter element only. This kit is the same as gasket kit 46430 with the addition of the element.

DISASSEMBLY PROCEDURES

1. Disassemble filter by removing six screws, six lockwashers and separate the filter head from the filter housing.
2. Remove conical spring.
3. Remove retainer spring assembly. (DO NOT disassemble unless it is necessary to replace individual parts.)
4. Remove inner seal, element and element gasket.
5. Remove filter seal from the filer head.
6. Clean all parts of the filter thoroughly.

REASSEMBLY PROCEDURES

1. Lubricate new element gasket and place on end of the element.
2. Insert end of element containing element gasket into the filter housing.
3. Lubricate new inner seal and insert into the exposed end of filter element.
4. Insert retainer assembly (hex nut end foremost) into the opening in the exposed end of the element.
5. Place conical spring, small end foremost, over screw-head end of retainer assembly.
6. Lubricate new filter seal and install on filter head.
7. Install filter head on filter housing and secure with six screws and lockwashers.

4.11 PARTS REPLACEMENT AND ADJUSTMENT PROCEDURES

AIR FILTER MAINTENANCE

Refer to Figure 4-4. Air Filter Maintenance should be performed when the air filter restriction indicator shows a red signal. The restriction indicator is located at the rear of the air filter housing. The air filter is equipped with a primary element and a secondary element. As previously stated the restriction indicator will alert you as to when the primary element maintenance is necessary. When removing the primary element always check the secondary element for visible dirt, grease, or damage. The secondary element must be changed after every sixth element cleaning or once a year, whichever comes first.

The primary element is a cleanable type element, however the secondary element is designed for replacement only - **do not clean the secondary element.**

ELEMENT REMOVAL

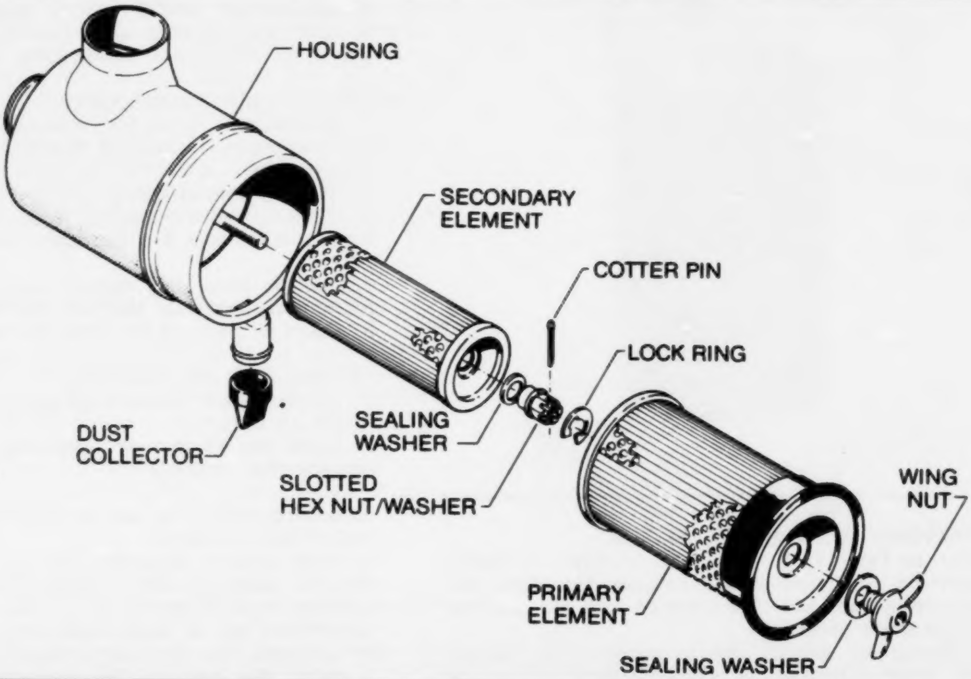
1. Clean the exterior of the air filter housing.
2. Remove the cover/element assembly by loosening the wingnut securing the cover/element assembly.
3. Pull the cover/element assembly out of the housing.
4. On the inside of the element, you will notice a lockring which fastens the cover to the element. Remove the lockring and pull the cover and element apart.
5. Clean the interior of the housing by using a damp cloth. Do not blow out dirt with compressed air.
6. Inspect the secondary element and replace if necessary, this element is not cleanable.
7. To remove the secondary element, remove the cotter pin and slotted hex nut/washer from the threaded rod running through the element and pull the element out of the housing.
8. Install the new secondary element and replace the sealing washer, slotted hex nut/washer and cotter pin.
9. With the secondary element in place, clean or replace the primary element. Cleaning instructions follow.

AIR FILTER ELEMENT CLEANING

The air filter element is cleanable by one of two methods. One method is by washing with clear water or clear water and a mild household detergent if the element is contaminated with grease or oily dirt. The other method is cleaning with compressed air. The maximum amount of times that an element should be cleaned is six (6) times; however, the element should be used no longer than a period of one (1) year without changing.

Prior to cleaning an element, check the element for damage. Damaged elements are to be replaced.
When cleaing an element, never exceed the recommended maximum pressures for water (40 psi/275KPa) or compressed air (30 psi/200KPa).

Figure 4-4. Air Filter



Do not strike the element against any hard surface to dislodge dust. This will damage the sealing surfaces and possibly rupture the element. Never "blow" dirt out of the interior of the filter housing: This may introduce dust downstream of the filter. Instead, use a clean damp cloth. Do not oil the element.

Method 1: Cleaning the Element by Washing.

When washing the element, never use petroleum solutions or solvents. Also, never immerse a dirty element in water or cleaning solution. This will carry dust onto the "clean side" (inside surface) of the element. Instead, dust must be removed by reverse flushing the element. Use clean clear water with a garden hose at no more than 40 psi, (275 KPa). Direct the water up and down the pleats in the filter media from the "clean side" of the element until all dust is removed. If, after washing as described above, the element is found to be contaminated with oil or greasy dirt, it should then be agitated in a solution of mild household detergent and water. Add 4 tabelspoons (10gms.) of detergent to one gallon (4 liters) of lukewarm water and mix well. After a sufficient amount of agitation has been done, rinse thoroughly and carefully shake out excess water. Lay the element on its side and allow to dry before installation. The element should be protected from dirt and/or freezing while drying. Mechanical drying methods can be used; however, heated air must be well-circulated and must not be over 180°F (82°C). Do not use a light bulb for drying. Also, compressed air must not be used for drying, as the pressure will rupture the element when wet. Regardless of the drying procedure, always inspect the element for damage prior to installation. (See element Inspection).

Method 2: Cleaning the Element with Compressor Air

When cleaning the element with compressed air, never let the air pressure exceed 30 psi (200 KPa). Reverse flush the element by directing the compressed air up and down the pleats in the filter media from the "clean side" of the element. Continue reverse flushing until all dust is removed. Should any oil or greasy dirt remain on the filter surface, the element sould then be cleaned by Method Number 1. When the element is satisfactorily cleaned, inspect thoroughly prior to installation. (See element inspection).

Element Inspection

1. Place a bright light inside the element to inspect for damage or leak holes. Concentrated light will shine through the element and disclose any holes.

2. Inspect all gaskets and gasket contact surfaces of the housing. Should faulty gaskets be evident, correct the condition immediately.
3. If the clean element is to be stored for later use, it must be stored in a clean container.
4. After the element has been installed, inspect and tighten, if necessary, all air inlet connections prior to resuming operation.

Primary Element Replacement

1. Place the element in position on the cover and replace thelockring to secure the cover and element.
2. Install the cover/element assembly and replace the wingnut. Tighten the wingnut so to fully seat the element gasket.

CONTROL SYSTEM ADJUSTMENT

Refer to Figure 4-5 and 4-6. The control system is designed to balance the compressor air delivery and the engine speed with varied demands for compressed air.

Initial Adjustment

The first step in control system adjustment is to adjust the control linkage between the engine governor and the Sullicon Control. Loosen the jam nuts at each end of the link rod and adjust the rod so that Sullicon Control lever just begins to move off of the full load stop screw. To make the adjustment, the rod must either be shortened or tightened. Turn the rod clockwise to increase the length or counterclockwise for a decrease in length. At this time check the inlet valve position. At full speed, the inlet valve should be wide open or approximately 15°-20° off of the vertical center line of the inlet valve.

NOTE

> The 15°-20° specification does not apply to the inlet valve lever. The above adjustments have been made to set the control system in the proper position for final adjustments.

Operating Adjustments

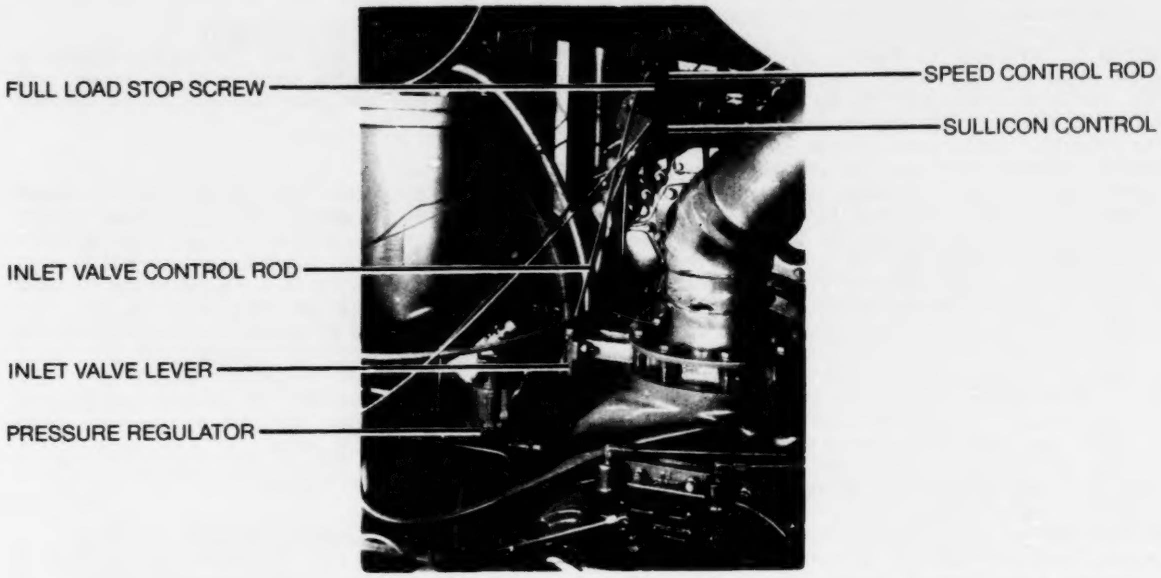
The next step is to start the machine according to the instructions in Section 3, Subsequent Startup. Allow the engine to operate until it reaches the normal operating temperature. Open the service valve until the engine speed increases to or approximately to the maximum specified operating speed.

Pressure Regulating Valve Adjustment

In some cases, after startup the engine speed may not rise to the proper RPM. In such cases it is possible that the pressure regulating valve is out of adjustment. To set the pressure regulating valve, open the service valve until the pressure gauge reads 100 PSIG. Check that the Sullicon Control lever is resting against the full load stop. Should you not be able to obtain a 100 PSIG reading, make the following adjustment. Turn the adjusting screw on the pressure regulating valve clockwise increasing the pressure at which the valve will open and apply pressure to the Sullicon control. As that adjustment is made, you will be able to obtain a higher pressure gauge reading.

Continue adjusting the pressure regulating valve until you are able to obtain a 100 PSIG reading with the Sullicon Control lever against the full load stop. When this is accomplished, turn the adjusting screw on the pressure regulating valve counterclockwise until the Sullicon Control lever just begins to move away from the full load stop. At this time, the compressor pressure setting is complete.

Figure 4-5 Control System Components



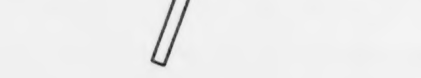
Engine Speed Adjustment

The next step on control system adjustment is to set the proper engine speed. When operating at 100 PSIG, the engine speed should be at the specified maximum operating speed; if not, a speed control rod adjustment will be necessary. Loosen the jam nuts on each end of the speed control rod and turn the rod either clockwise for speed increase or counterclockwise for a speed decrease.

Idle Speed Adjustment

The last step in the capacity control system adjustment is the engine idle speed and compressor inlet valve adjustment. This is done by adjusting the length of the inlet control rod. First, close the service valve; at this time, the Sullicon Control lever will move away from the full load stop and the engine speed will drastically reduce. The engine speed should reduce to the engine idle speed specified in Section 2. Should the engine speed be other than that which is specified, loosen the locknuts at each end of the inlet control rod and turn the rod clockwise for speed increase or counterclockwise for speed decrease. Once the engine idle is running at the specified speed, check the position of the inlet valve. When running at idle speed, the inlet valve should be closed; air pressure should then stabilize, if not, it will be necessary to adjust the inlet valve lever. Loosen the set screw securing the lever and position the inlet valve in the closed position. Retighten the set screw and recheck the idle speed.

Figure 4-6 Inlet Valve Position



Final Check
At this time the capacity control system should be ready for operation; however, a final check of all specified speeds and pressures must be made. With the use of the service valve, cycle the machine from full load to no load and make these checks. Following a thorough check, the machine will be ready for operation.

SEPARATOR ELEMENT REPLACEMENT
When oil carry over is evident after the oil return line strainer and orifice as well as the blowdown valve diaphragm have been inspected and found to be in satisfactory condition, separator element replacement is necessary. Use separator replacement kit number 11399 and follow the procedure explained below.

1. Remove all piping connected to the sump cover to allow removal (return line service line etc).

2. Remove the oil return line from the fitting in the cover.
3. Remove the cover bolts and lift the cover from the sump with the minimum pressure valve in place.
4. Remove the separator element.
5. Scrape the old gasket material from the cover and the flange on the sump.
6. Install the Gaskets
7. Install the Element
8. Replace the sump cover and bolts. Run the cover bolts in finger tight, then gradually tighten in a criss-cross pattern in 4 to 5 steps. Always tighten the bolts alternately at opposite sides of the cover. Never tighten bolts adjacent to each other. Torque bolts to 100-120 FT-LBS (140-170 Nm).
9. Reconnect all piping. The oil return line should extend to the bottom of the separator element or no more than 1/2" up from the bottom. This will assure the proper oil return flow.
10. Clean the oil return line strainer and clear the orifice prior to restarting the machine.

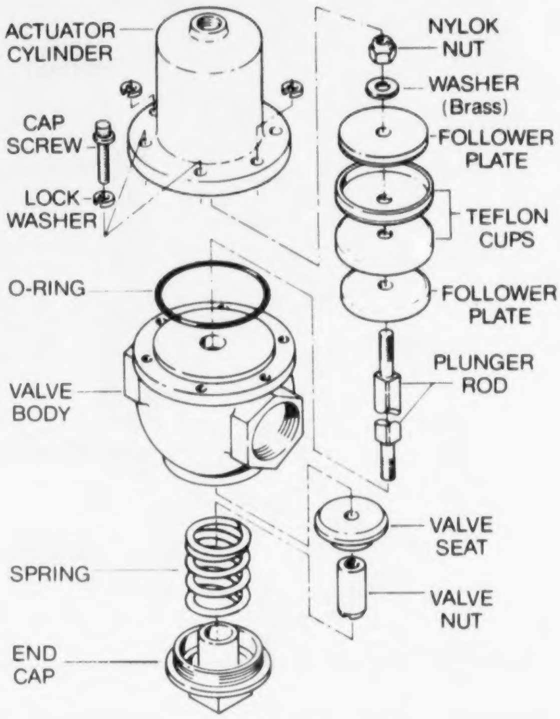
FLOW CONTROL VALVE MAINTENANCE
Refer to Figure 4-7. When servicing flow control valve Number 14098, use repair kit number 1109.

The following instructions are in accordance with repair kit number 1109:

1. Remove the capscrews securing the cylinder to the valve body and remove the cylinder.
2. Disassemble the teflon retainer plate cups and follower plates from the plunger rod by removing the 1/4 nyloc nut on the end of the rod.
3. Discard your old teflon cups and nyloc nut. Replace these with the new ones provided in the kit. When reassembling, replace the 1/4 nyloc nut also.
4. Remove and replace the valve body O ring and reassemble the cylinder to the valve body.

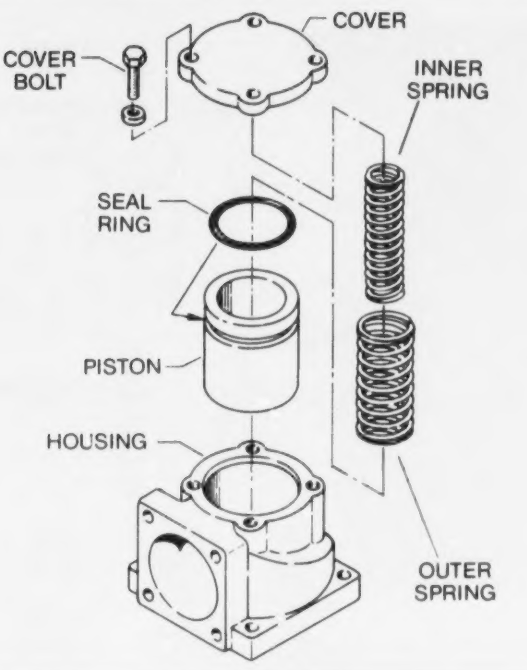
MINIMUM PRESSURE VALVE MAINTENANCE
Refer to Figure 4-8. Minimum pressure valve maintenance is quite minimal. The only part which normally requires replacement is the seal ring on the piston. To replace the seal ring, follow the procedure explained below:

Figure 4-7 Flow Control Valve



1. Remove two of the four 1/2" capscrews on opposite corners of the cover.
2. Install 1/2 threaded rods approximately 6" long with nuts to hold the cover in place.
3. Remove the other two capscrews.
4. Back off the nuts evenly to remove the cover and springs.
5. Remove the four Allen head bolts which secure the housing and adapter.
6. Remove O rings from housing and adapter.
7. Remove piston (replace if worn).
8. Remove seal ring.
9. Clean piston.
10. Replace seal ring.
11. Coat piston and seal with Parker Super O Ring Seal or equivalent quality grease.
12. Install new O rings in housing and adapter and replace the housing and adapter. When installing Allen head capscrews use Loctite pipe sealant or equivalent in the threads.
13. Replace piston.
14. Replace springs.
15. Replace the cover by installing the 1/2" threaded rods with the nuts in opposite corners and tighten the nuts. After the cover is in place, install two (2) capscrews in the remaining two holes.
16. Remove the threaded rods and install the other two (2) capscrews.

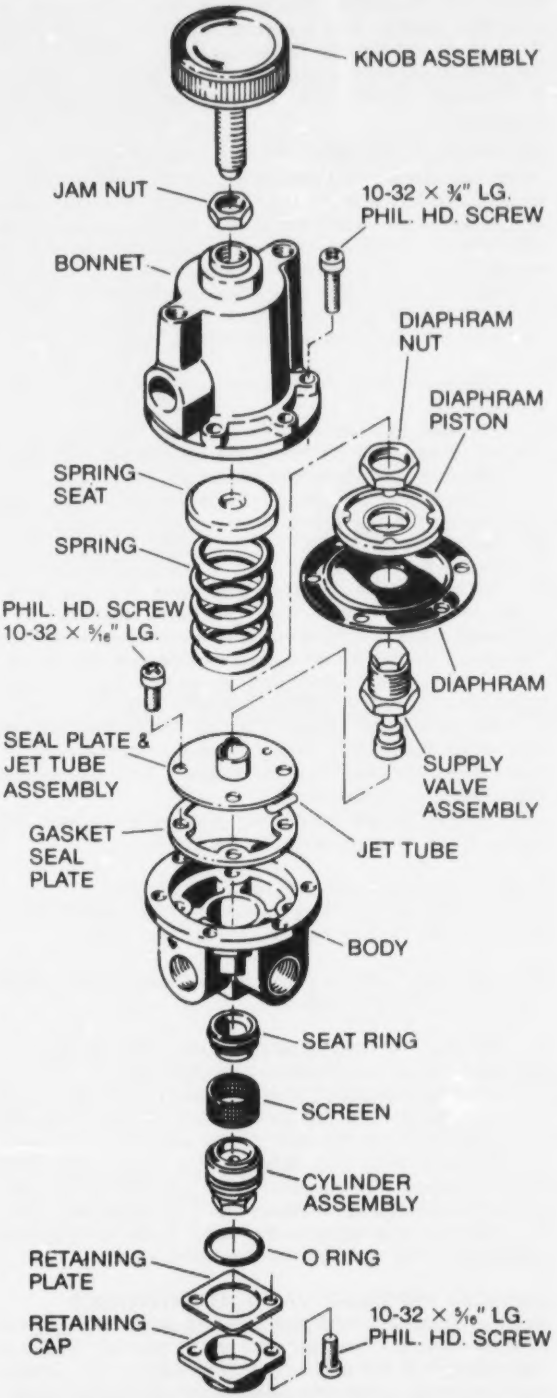
Figure 4-8 Minimum Pressure Valve


COVER
COVER BOLT
INNER SPRING
SEAL RING
PISTON
HOUSING
OUTER SPRING

PRESSURE REGULATOR VALVE MAINTENANCE
Refer to Figure 4-9. Under normal circumstances the only components the Pressure Regulator Valve which would require maintenance are the diaphram assembly, seal plate gaster, seat ring, screen and cylinder. These parts are all provided in kit No. 12548. Use this kit and follow the instructions below to properly repair the Pressure Regulator Valve.

1. Loosen the jam nut under the knob assembly and turn the knob assembly counter clockwise until the spring tension is relieved.
2. Next, remove the six phillips head screws around the circumference of the bonnet.
3. Pull the bonnet away from the body. This will allow the removal of the spring seat and spring.
4. After removing the spring and spring seat remove the diaphragm assembly. This assembly consists of the Diaphragm Nut, Diaphragm Piston, Diaphragm, and Supply Valve Assembly. There is no need to disassemble the Diaphragm Assembly.
5. Remove the four phillips head screws which secure the seal plate and jet tube assembly and pull the assembly from the body. Care must be taken when removing the seal plate and jet tube assembly so not to damage the jet tube. The seal plate and jet tube assembly may become bonded to the body and gasket and will not pull away from the body readily. However, moderate pressure applied alternately from side to side on the center raised portion of the seal plate should break the bond loose.

Figure 4-9 Pressure Regulator Valve


KNOB ASSEMBLY
JAM NUT
10-32 × ¾" LG. PHIL. HD. SCREW
BONNET
DIAPHRAM NUT
DIAPHRAM PISTON
SPRING SEAT
SPRING
PHIL. HD. SCREW 10-32 × 5/16" LG.
DIAPHRAM
SEAL PLATE & JET TUBE ASSEMBLY
SUPPLY VALVE ASSEMBLY
GASKET SEAL PLATE
JET TUBE
BODY
SEAT RING
SCREEN
CYLINDER ASSEMBLY
RETAINING PLATE
O RING
RETAINING CAP
10-32 × 5/16" LG. PHIL. HD. SCREW

6. Remove and discard the seal plate gasket.
7. Next, remove the two phillips head screws which secure the retaining cap and plate. From the top side, push the blunt end of a pencil sized rod through the center of the body pushing the seat ring, screen and cylinder assembly out the bottom.
8. Before opening the loose parts provided in the kit, discard the old cylinder assembly, screen, seal plate gasket, seat ring and diaphragm assembly.
9. Place the new seal plate gasket in position on the body and replace the seal plate and jet tube assembly.

NOTE

> The jet tube must be positioned in the port at which the pressure signal enters the valve, i.e... The port connected to the pressure line running directly from the sump.

Replace and tighten the phillips head screw securely.

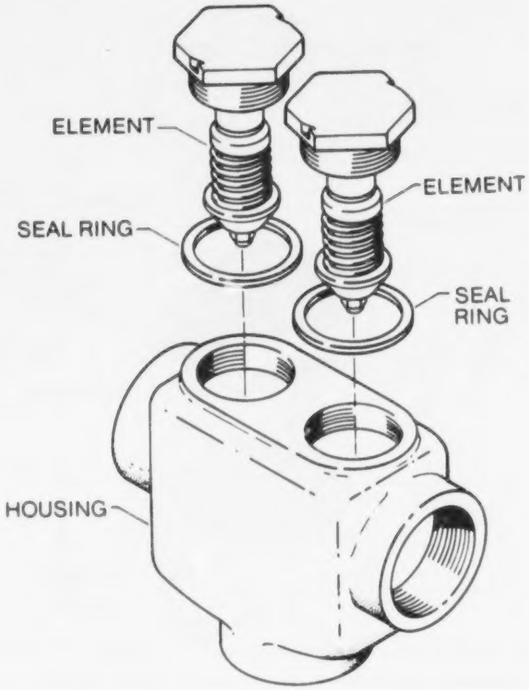
10. Push the new seat ring (positioned as shown) into the body.
11. Place the new O ring and screen on the cylinder assembly, and push the cylinder assembly into the body.
12. Reposition the retaining plate and retaining cap and replace the two phillips head screws which hold them in place.
13. Push the new diaphragm assembly through the center hole of the seal plate and align the holes in the diaphragm with those in the body.
14. Place the spring and spring seat over the center of the seal plate.
15. Place the bonnet over the remainder of the valve assembly and replace the screws securing the bonnet to the body.
16. This completes the repair of the Pressure Regulator Valve. However, the valve must now be adjusted to the desired pressure settings. Refer to "Control System Adjustments" of this section of the manual.

THERMAL VALVE MAINTENANCE
Refer to Figure 4-10 thermal valve maintenance on this machine will only require a changing of the thermostatic elements. Use element 44583 for replacement and follow the procedure explained below.

1. With the machine shutdown, loosen and remove both elements and sealing washers from the housing. Visually inspect the housing and valve seat for a possible burr or obstruction. Should either exist, remove it. In such cases, if the element is not damaged it may be reinstalled.
2. Before installing a new or existing element, be sure that all of the threads on the housing are clean and free of dirt.
3. Install the elements and sealing washers and securely tighten.

BLOWDOWN VALVE DIAPHRAGM REPLACEMENT
Refer to Figure 4-11. To replace the blowdown valve diaphragm, use replacement diaphragm No. 40273 *and follow the instructions provided below.*

Figure 4-10 Thermal Valve



1. Disconnect the appropriate tubing to allow easy valve disassembly.
2. Remove the six phillips head screws which hold the upper and lower bodies together.
3. Pull the two bodies apart and discard the old diaphragm.
4. Replace the old diaphragm with the new one and position the upper and lower bodies together as they were prior to disassembly.
5. Replace the six screws by tightening at opposite corners and reconnect the disconnected tubing.
6. After the above steps have been taken, start the machine and cycle to full load to be sure that everything is in working order.

DISCHARGE CHECK VALVE MAINTENANCE
Refer to Figure 4-12. Seldom if ever will it be necessary to perform any maintenance operations on the discharge valve. However, it may at some time be necessary to change the internal O ring. Follow the instructions provided below when removing or servicing the discharge valve.

1. Disassemble the Flexmaster™ coupling on the discharge piping between the compressor unit and the sump.
2. Remove the four capscrews which secure the cover to the housing and pull the cover away from the housing.
3. Pull the plunger and spring off of the cover.

Figure 4-11 Blowdown Valve

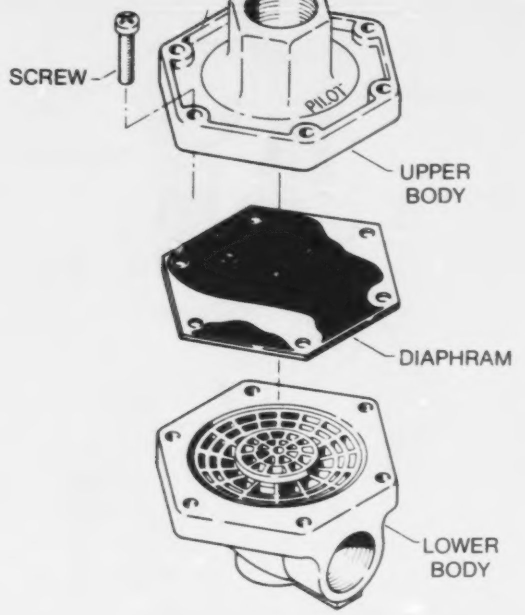
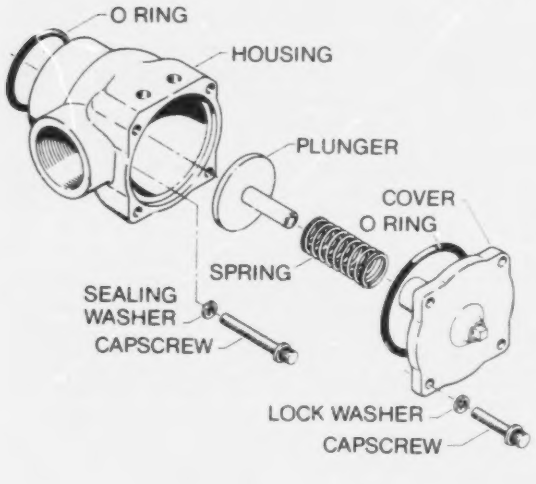


Figure 4-12 Discharge Check Valve



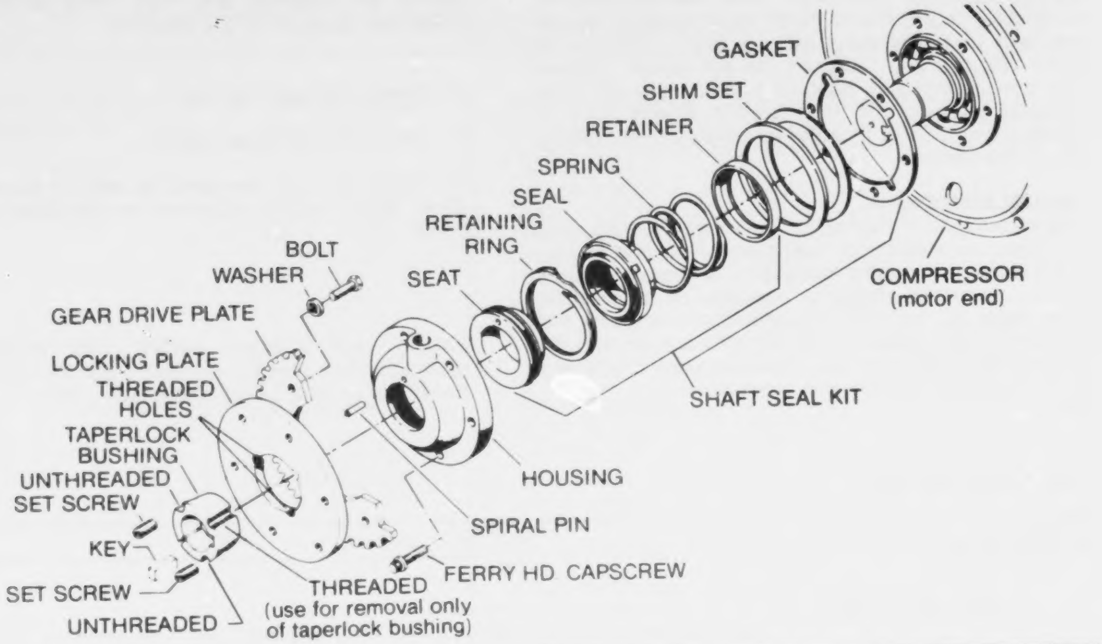
4. Next, remove the four capscrews which fasten the housing to the compressor unit. These capscrews are located inside of the housing.
5. The housing should now fall away from the compressor unit allowing access to the O ring which seals housing and compressor unit. Remove and discard that O ring and replace it with a new one.
6. Remove and discard the O ring on the cover and replace it with a new one.
7. Position the housing back in place on the compressor unit and replace the capscrews which secure the housing. Be sure that the sealing washers and backup washers are replaced as well.
8. Check the spring and plunger for scoring, polishing, or wear.
9. Place the spring and plunger in position in the cover and place those three parts in position on the housing as they were prior to disassembly.
10. Replace the four capscrews to secure the cover to the housing and reconnect all disconnected piping.
11. Replace the Flexmaster™ coupling and start the machine to check for leaks. If the rubber gaskets on the flexmaster are hard, brittle, or damaged they must be replaced.

SHAFT SEAL REPLACEMENT

Refer to Figure 4-13. For shaft seal replacement use repair kit No. 13498 and follow the procedure explained below.

1. Following the removal of the compressor unit and prior to any further disassembly, scribe a mark on the input shaft at the face of the taper lock bushing. This mark is made to assure that the drive hub assembly is reassembled properly.
2. Remove the two set screws from the taperlock bushing. Oil one of the set screws and thread it into the third threaded hole (hole previously left without a set screw) to expand the bushing and slide the drive hub off the shaft.
3. Disconnect the tube line from the housing.
4. Remove the 5/16'' capscrews which secure the seal housing to the remainder of the compressor unit and tap around the housing bolt circle with a hammer to break the gasket seal.
5. With a screw driver, pry the housing from the compressor unit. After removing the housing pull the shims away from the housing.
6. The axial end play of the shaft is adjusted by use of shims on the shaft seal housing. Care must be taken so not to damage these shims as they must be reinstalled at reassembly.
7. Remove the retaining ring from the housing.
8. Press the old seat from the housing. Be absolutely sure that the housing is supported well enough to tolerate the stress which is present when pressing the seal out. If the 1/8'' diameter spring pin is worn or damaged, remove it from the seal housing.
9. Remove the seal from the shaft. It will be necessary to break between the shaft and the rubber bellows of the seal. This can be done by pushing the seal further towards the compressor unit prior to pulling it off the shaft. Do not score the shaft.

Figure 4-13 Shaft Seal Replacement


GASKET
SHIM SET
RETAINER
SPRING
SEAL
RETAINING RING
BOLT
WASHER
SEAT
COMPRESSOR (motor end)
GEAR DRIVE PLATE
LOCKING PLATE
THREADED HOLES
TAPERLOCK BUSHING
UNTHREADED SET SCREW
SHAFT SEAL KIT
HOUSING
KEY
SPIRAL PIN
FERRY HD CAPSCREW
SET SCREW
THREADED (use for removal only of taperlock bushing)
UNTHREADED

10. Pull the spring and retainer off of the shaft and clean the old gasket material off of the surfaces of the compressor unit and the seal housing. Be careful not to allow old gasket material to come in contact with the exposed bearings.
11. Check the shaft for burrs and sharp edges. The new seal must slide over the shaft, and sharp edges could easily damage the seal. Break all sharp edges and clean the shaft with emery cloth. Remove all metal particals.
12. By tapping lightly with a hammer, install the new spring pin in the seal housing. It must protrude 1/8" - 3/16" (3-5 mm) inside the seal housing. The pin may extend through the exterior of the housing.
13. Lightly coat the seat and the bore of the seal housing with clean oil. By hand, press the new seat with the O ring in place into the bore with the lapped surface (highly polished surface) facing out. Be sure to align the small hole in the seat with the spiral pin.

IMPORTANT

> Care must be taken in handling the seat. Do not scratch the lapped surface. Place oil on your thumbs prior to pressing the seal in place. After the seat is in squarely in position, replace the retaining ring. Using a thin feeler guage, check to see if the seat is squarely seated against the bottom of the bore in the seal housing.

14. Replace the retainer and spring and lightly coat the inside diameter and lapped carbon surface of the seal with clean oil.
15. Install the new seal by carefully sliding it over the shaft with the lapped surface facing towards the end of the shaft. Slide it down the shaft until the tension of the spring is realized. Extreme care must be taken not to cut the rubber bellows on the inside diameter of the new seal. The seal must slide and seat squarely over the shaft by hand force. Should the seal become cocked on the shaft, remove and start over. Excessive force should not be necessary. Final positioning is accomplished when installing the seal housing.
16. Reposition the shim set which was previously removed.
17. With a small wire, clear the orifice of the seal housing. Place the new gasket against the flange of the shaft seal housing and line both pieces up with the bolt circle of the compressor unit. Push squarely and slowly against the spring. Force until the housing makes contact with the compressor unit. Install and torque the capscrews to 17-19 ft LBS (24-26Nm).
18. Reconnect the oil line to the housing.
19. Put the drive hub assembly back in place on the shaft lining up the taper-lock bushing, with the line previously scribed on the shaft (13/16" - 7/8" (21-22mm) from the end of the shaft). When installing the bushing, be sure the shaft is clean. Oil the threads and point on the set screw. After aligning the half

holes with those of the locking plate, tighten the set screws alternately and evenly until they are torqued to 35-37 FT/LBS (49-52 Nm). Next hammer against the face of the bushing using a sleeve or block to avoid damage and retighten the set screws. Repeat the hammering and tightening procedure until the bushing is back into the position it was prior to disassembly. At this time the compressor unit is ready for re-installation.

4.12 TROUBLESHOOTING

The information contained in the troubleshooting chart has been compiled from field report data and factory experience. It contains symptoms and usual causes for the described problems; however, do not assume that these are the only problems that may occur. All available data concerning the trouble should be systematically analyzed before undertaking any repairs or component replacement procedures.

A detailed visual inspection is worth performing for almost all problems and may avoid unnecessary additional damage to the machine.

- Check for loose wiring.
- Check for damaged piping.
- Check for parts damaged by heat or an electrical short circuit, usually apparent by discoloration or a burnt odor.

Should your problem persist after making the recommended checks, consult your nearest Sullair distributor or the Sullair Corporation factory.

TROUBLESHOOTING

SYMPTOM	*PROBABLE CAUSE AND REMEDY*
1. Machine will not start.	1. No fuel. a. Check fuel level and add fuel if necessary. 2. Plugged fuel filter. a. Replace the element. 3. Low battery voltage. a. Check electrolyte level and add water, and recharge if necessary. b. Loose battery cables, tighten cables. c. Dirty battery cables, clean thoroughly. 4. Plugged air filter. a. Clean or replace the element. 5. Engine problems may have developed, refer to your Engine Manual. 6. Defective engine oil pressure switch, engine water temperature switch or compressor discharge temperature switch. a. Check continuity flow and replace if necessary. 7. Blown fuse. a. Check continuity and replace if necessary. 8. Defective Fuel Rack Solenoid. a. Check and Replace if necessary.
2. Machine shuts down with air demand present.	1. No fuel. a. Check fuel gauge and add fuel if necessary. 2. Compressor discharge temperature switch is open. a. Cooling air flow is insufficient, clean cooler and check for proper ventilation. b. Low oil sump level; add oil. c. Dirty oil; change oil. d. Clogged oil filters; change bearing filter element and clean the main oil filter element. e. The thermal valve is not functioning properly; change the thermostat elements.

TROUBLESHOOTING

SYMPTOM	*PROBABLE CAUSE AND REMEDY*
2 Machine shuts down with air demand present (continued).	f. Defective discharge temperature switch; check for a short or open circuit to the fuel rack solenoid. Should this check out normal, it would be possible that the temperature switch itself is defective. 3. Defective engine oil pressure switch. a. Check continuity flow and replace if necessary. 4. Engine water temperature switch is open. a. Cooling air flow restricted. Clean the radiator core. b. Low water level. c. Defective switch, replace. 5. Blown fuse in wiring harness. a. Check continuity and replace if necessary.
3. Machine will not build up full discharge pressure.	1. Air demand too great. a. Check service lines for leaks or open valves. 2. Dirty air filter. a. Check the filter indicator and change or clean element if required. 3. Pressure regulator out of adjustment. a. Adjust regulator according to control adjustment instructions in the Maintenance Section. 4. Defective pressure regulator. a. Check diaphragms and replace if necessary (kit available). 5. Defective minimum pressure valve. a. Check that piston is moving freely.
4. Improper unloading with an excessive pressure buildup causing pressure relief valve to open.	1. Pressure regulating valve is set too high. a. Readjust. 2. Leak in the control system causing loss of pressure signal. a. Check control lines. b. Defective diaphragms in the Sullicon Control; replace diaphragms (kit available). c. Defective pressure regulating valve; repair valve (kit available). 3. Inlet valve jammed. a. Free valve or replace valve. 4. Restriction in the control system. a. Check all control lines and components. Ice and other contaminants could cause restrictions. 5. Jammed control linkage. a. Free the jammed portion of the linkage and adjust if necessary. 6. Defective pressure relief valve. a. Replace pressure relief valve. 7. Plugged air/oil separator element. a. Replace separator element.

TROUBLESHOOTING

SYMPTOM	*PROBABLE CAUSE AND REMEDY*
5. Insufficient air delivery.	1. Plugged air filter. a. Clean or replace element. 2. Plugged air/oil separator. a. Replace separator element and also change compressor oil and oil filter at this time. 3. Faulty pressure regulator. a. Adjust or repair. 4. Engine speed too low. a. Readjust engine speed.
6. Excessive Compressor Oil Consumption.	1. Clogged return line. a. Clean oil return strainer and orifice. 2. Defective blowdown valve diaphragm. a. Replace diaphragm. 3. Leak in the lubrication system. a. Check all pipes, connections and components. 4. Separator element damaged or not functioning properly. a. Change separator element.
7. Compressor Overheating	1. Loose or broken fan belt. a. Tighten or change belt. 2. Dirty oil cooler core. a. Clean core thoroughly. 3. Faulty thermostat in thermal valve. a. Change thermostat elements. 4. Plugged oil cooler tubes (internal). a. Clean tubes thoroughly. 5. Low sump oil level. a. Fill. 6. Plugged compressor oil filter. a. Clean the main oil filter element. b. Change bearing oil filter element. 7. Plugged oil return line. a. Clean oil return strainer and orifice.
8. Engine Overheating	1. Loose or broken fan belt. a. Tighten or change belt. 2. Dirty radiator core. a. Clean thoroughly. 3. Low water level. a. Refill. 4. Faulty engine thermostats. a. Replace thermostat. 5. Plugged radiator. a. Clean thoroughly. 6. Low oil level. a. Refill. 7. Defective water pump. a. Change pump. 8. Other engine problems. a. Refer to engine manual.

ILLUSTRATIONS AND PARTS LISTS

PROCEDURE FOR ORDERING PARTS

Parts should be ordered from the nearest Sullair Distributor or the Distributor from whom the machine was purchased. If for any reason parts cannot be obtained in this manner, contact the factory directly at the address below.

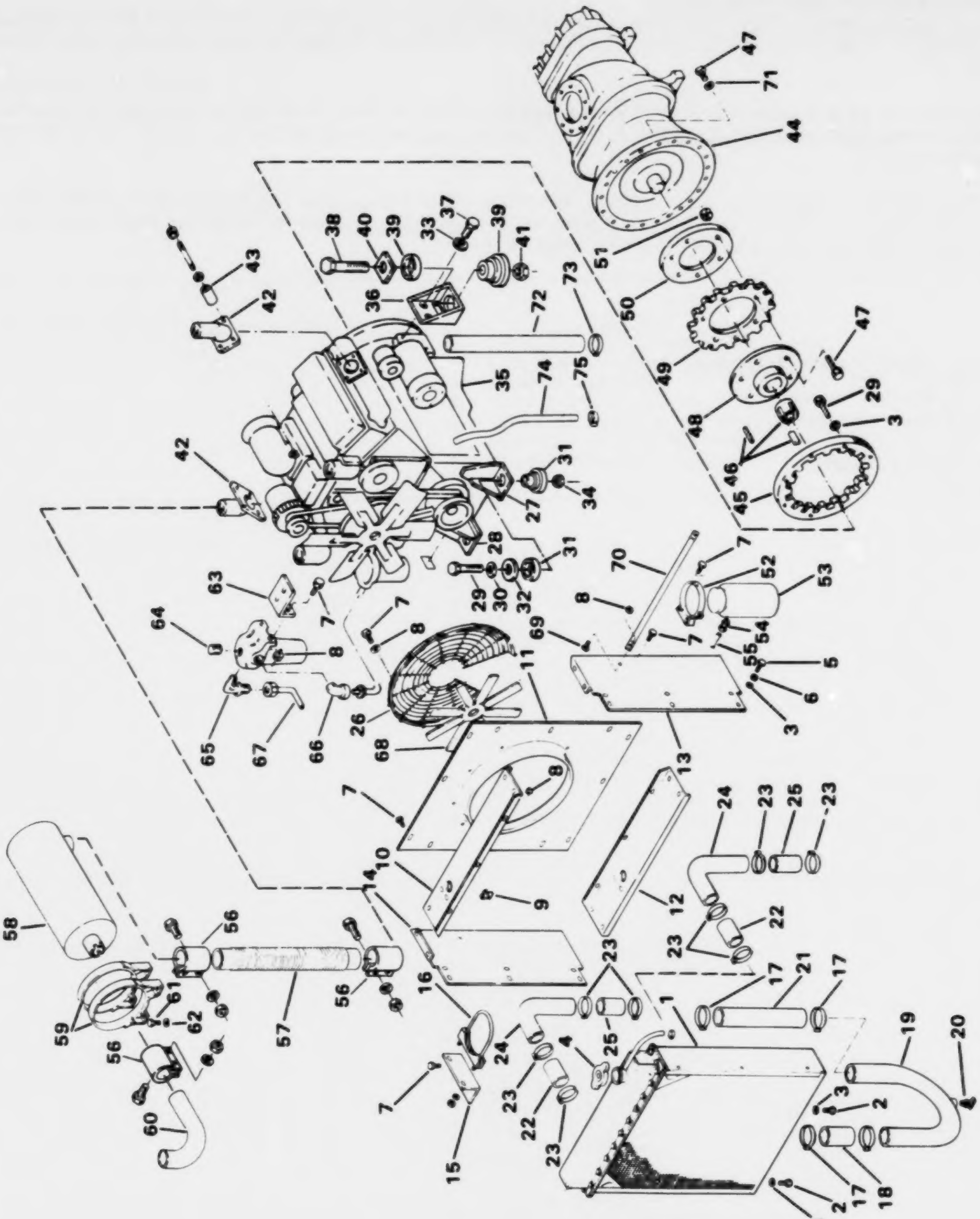
When ordering parts always indicate the **Serial Number** of the machine. This can be obtained from the Bill of Lading for the machine or from the Serial Number Plate located on the left end of the machine when facing the instrument panel.

Standard fasteners (capscrews, nuts, washers, etc.) tubing and fittings plus other standard hardware have not been included in the Parts List. Standard Pipe is 150# malleable, galvanized. These are items which can be obtained quicker and more economically from local sources.

SULLAIR CORPORATION
3700 East Michigan Boulevard
Michigan City, Indiana 46360

Telephone (219) 879-8211
Telex: 258318

Section 5
ILLUSTRATIONS AND PARTS LISTS
5.1 COMPRESSOR, ENGINE AND PARTS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Section 5
ILLUSTRATIONS AND PARTS LISTS

5.1 COMPRESSOR, ENGINE AND PARTS

key no.	*description*	*part no.*	*qty.*
1	radiator	47725	1
2	capscrew, hex hd, 1/2"-13nc x 2 1/2"	*	2
3	washer, lock, 1/2"	*	18
4	cap, radiator	42018	1
5	capscrew, hex hd, 1/2"-13nc x 1"	*	6
6	washer, plain, 1/2"	*	3
7	capscrew, hex hd 5/16"-18nc x 3/4"	*	66
8	nut, hex, 5/16"-18nc	*	70
9	nut, clip, 5/16"-18nc	*	12
10	panel, fan shroud (top)	220329	1
11	panel, venturi	220330	1
12	panel, fan shroud (bottom)	221570	1
13	panel, shroud, r.h. side	220327	1
14	panel, shroud, l.h. side	220328	1
15	angle, pipe brace	221615	1
16	clamp, pipe, 1 3/4"	40155	1
17	clamp, hose, 3"	40343	4
18	hose, flexible, 2 3/4" x 6"	41204	1
19	tube, radiator outlet	14102	1
20	drain cock, 1/8"	40032	1
21	hose, flexible, 2 3/4" x 14"	49583	1
22	hose, radiator, 2 1/4" x 8"	49565	2
23	clamp, hose	40083	8
24	tube, upper radiator	25589	2
25	hose, rubber, 2 1/4" x 4"	44203	2
26	guard, fan	49885	1
27	bracket, right hand, engine	14312	1
28	bracket, left hand, engine	14311	1
29	capscrew, hex hd, 1/2"-13nc x 1 1/2"	*	8
30	washer, plain, 5/8"	*	2
31	isolator, vibration	49781	2
32	washer, snubbing, 3"	26690	2
33	washer, lock, 5/8"	*	10
34	locknut, hex, ⅝"-11	*	2
35	engine	40280	1
36	bracket, rear, engine mounting	14310	2
37	capscrew, hex hd, 5/8"-11nc x 1 1/2"	*	8
38	capscrew, hex hd, 1"-8nc × 6"	*	2
39	isolator, vibration	49717	2
40	washer, snubbing, 6"	222607	2

(continued on next page)

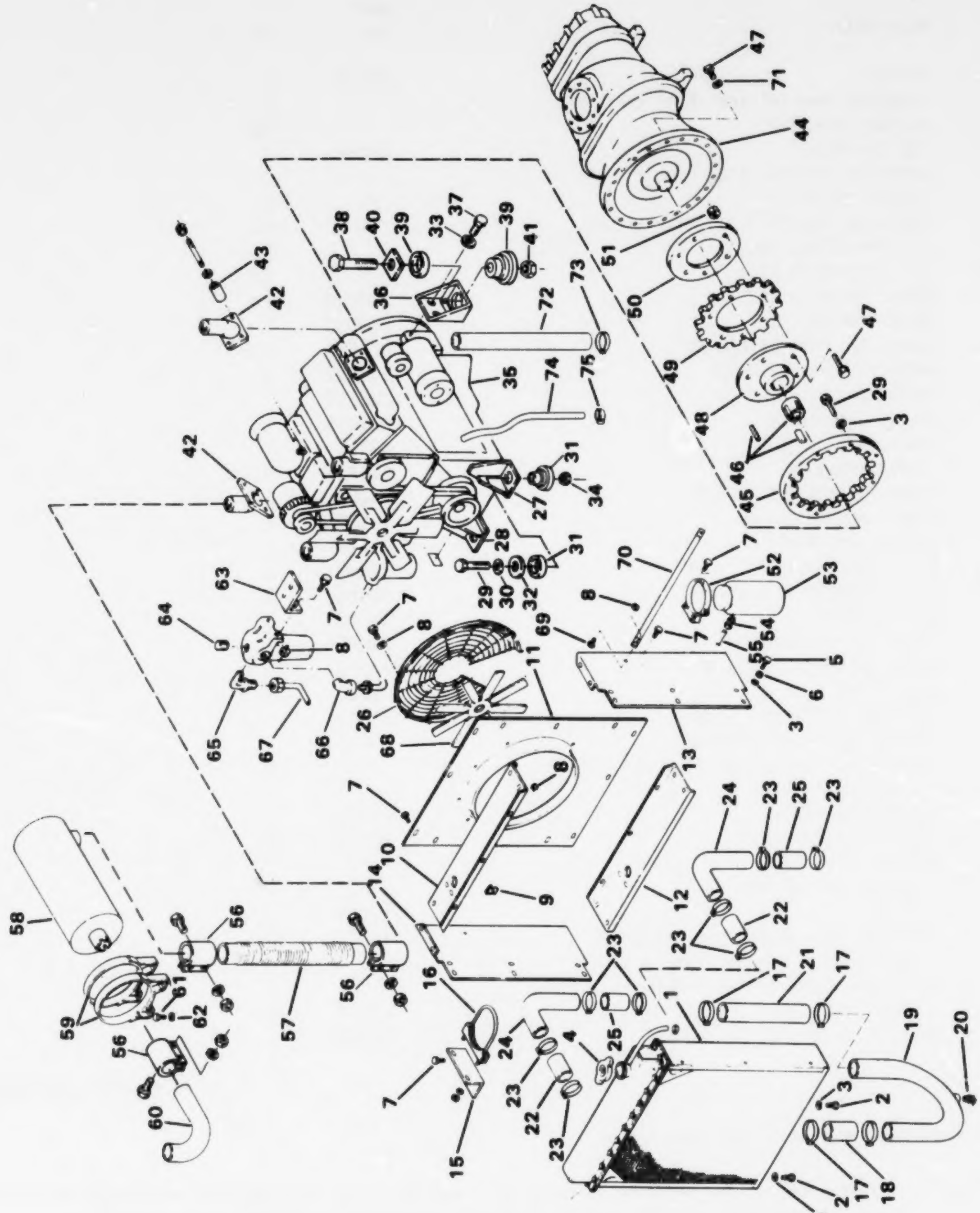
* Standard hardware item, purchase locally.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5

ILLUSTRATIONS AND PARTS LISTS

5.1 COMPRESSOR, ENGINE AND PARTS



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5.1 COMPRESSOR, ENGINE AND PARTS continued

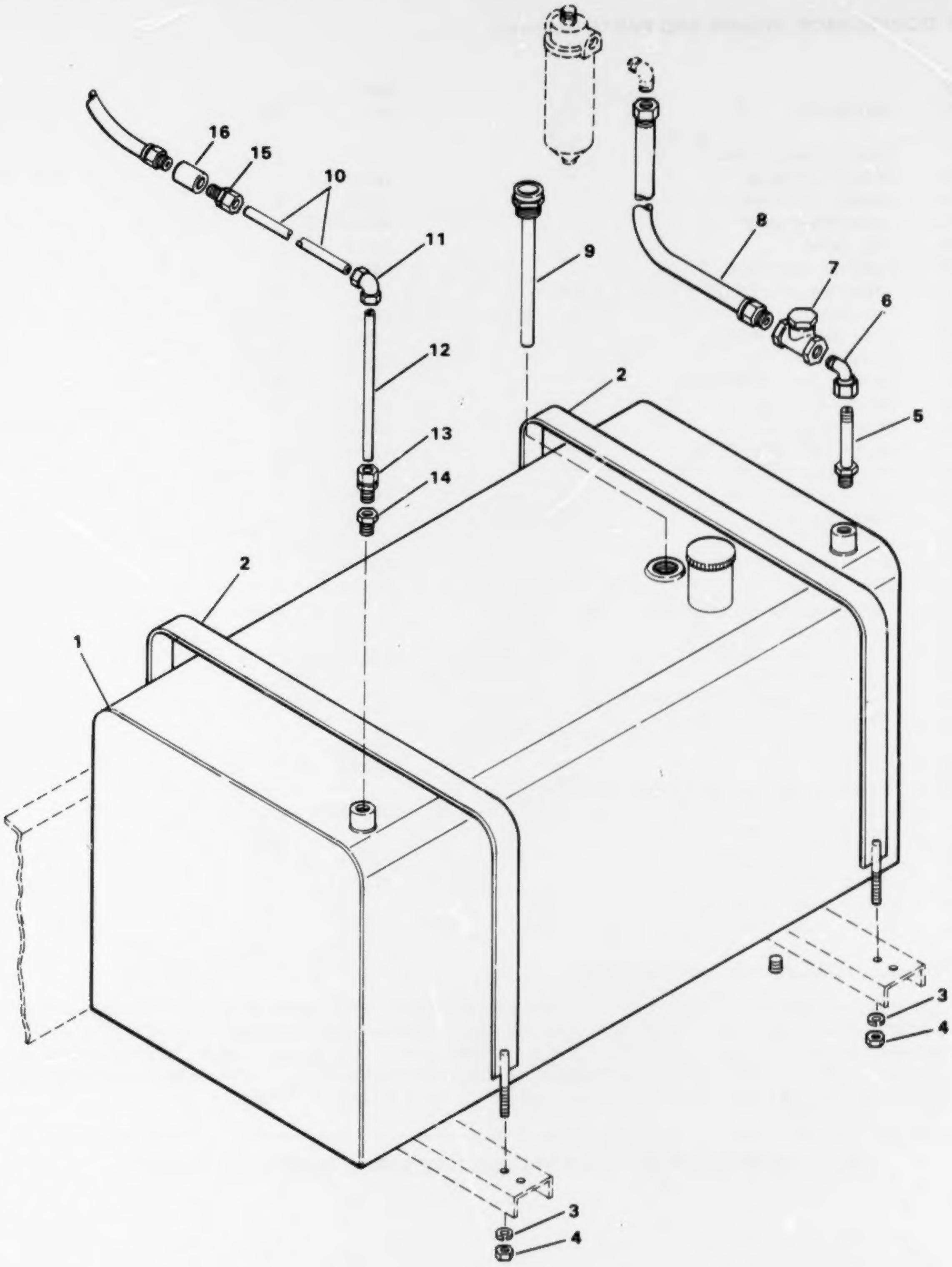
key no.	*description*	*part no.*	*qty.*
41	locknut, hex, 1"-8nc	*	2
42	adapter, exhaust	14157	2
43	spacer, manifold	22207	8
44	compressor unit**	10947-110	1
45	ring, drive	44766	1
46	bushing, taperlock	44763	1
47	capscrew, hex hd, 7/16"-14nc x 1 3/4"	*	30
48	hub, drive	26527	1
49	gear, drive	12888	1
50	plate, drive	26470	1
51	locknut, hex, 7/16"-14nc	*	6
52	band, mounting, 6"	42283	1
53	bottle, plastic	42287	1
54	union, bulkhead, 5/16"	42288	1
55	tubing, steel, 5/16"	*	2
56	clamp, exhaust, 3"	49660	6
57	pipe, flexible	49409	2
58	muffler	49759	2
59	band, mounting, 10"	40194	4
60	pipe, exhaust	49659	2
61	capscrew, hex hd 1/4"-20nc x 1/2"	*	2
62	washer, lock, 1/4"	*	2
63	bracket, fuel strainer	20319	1
64	plug, pipe, 3/8"	*	2
65	elbow, 45° flare, 1/2"t x 3/8"p	*	1
66	elbow, 90°, street, 3/8"	*	1
67	hose, fuel, 1/2" x 36"	40346	1
68	fan	49024	1
69	capscrew, hex hd, 5/16"-18nc x 1"	*	12
70	angle, cooler	221581	2
71	washer, lock 7/16"	*	24
72	hose, flexible, 1 1/4"	45971	3
73	clamp, hose, 1 1/4"	40513	1
74	hose, rubber, 5/16"	*	6
75	clamp, hose, 1/2"	43197	1

* Standard hardware item, purchase locally.

** The shaft seal is the only spare part which may be purchased for the compressor unit. Any other part replacements must be made at the factory. Tampering with internal parts other than the shaft seal will void all Sullair Warranty obligations concerning the compressor unit. There is an exchange program where a reconditioned (warranteed) compressor unit can be obtained from the factory for the price of reconditioning your unit. The shaft seal repair kit for your compressor unit is part no. 13498.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

5.2 FUEL TANK AND PIPING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5.2 FUEL TANK AND PIPING

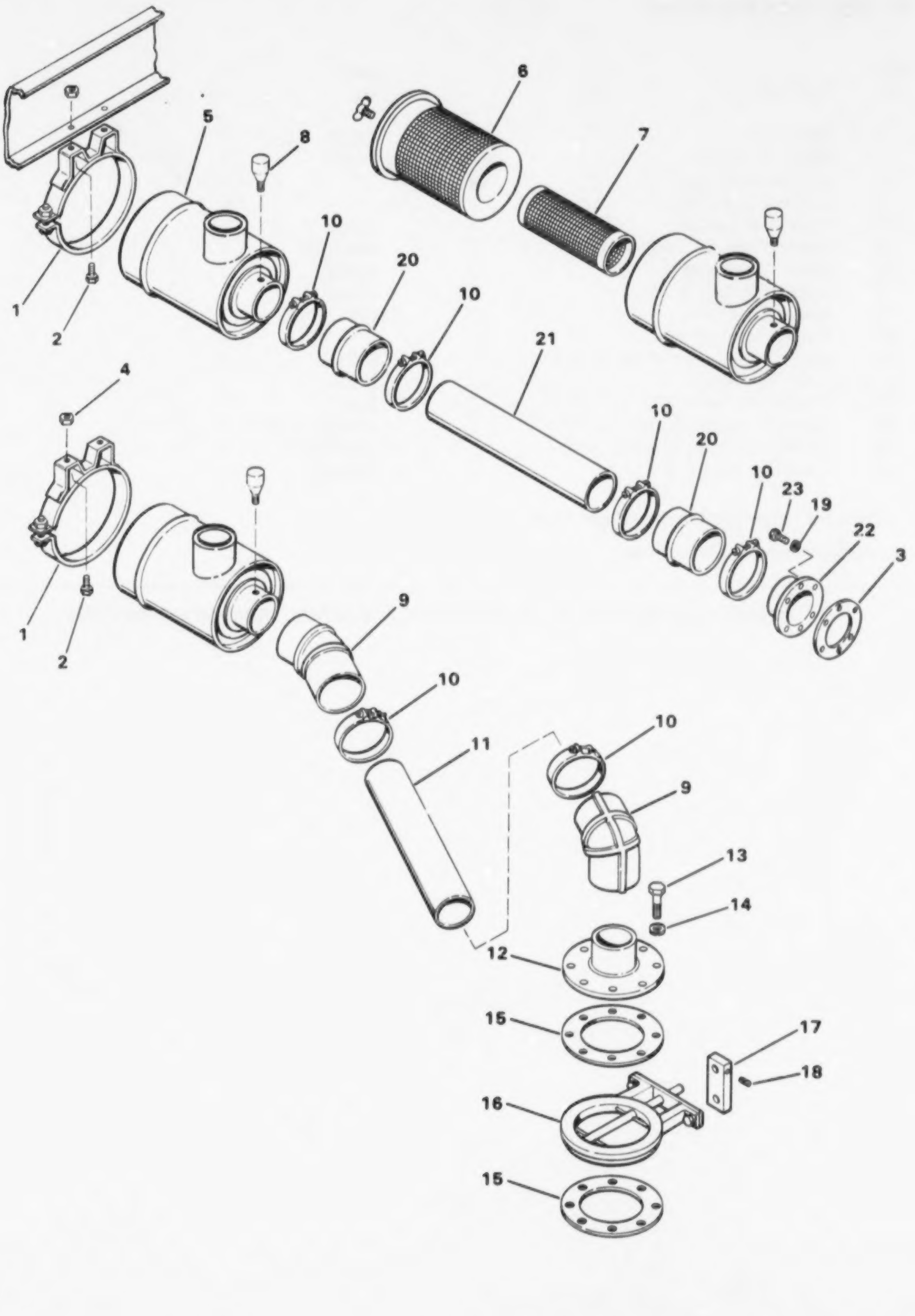
key no.	*description*	*part no.*	*qty.*
1	tank, fuel	47828	1
2	strap, fuel tank	14189	2
3	washer, lock 3/8"	*	4
4	nut, hex 3/8"-16nc	*	4
5	tube, fuel suction	12783	1
6	elbow, tube, 90°, 1/2"t x 3/8"p	8405X8**	1
7	valve, check, 3/8"	40408	1
8	hose, fuel, 1/2" x 36"	40346	1
9	gauge, fuel level	40641	1
10	tubing, steel, 5/16"	*	4
11	elbow, tube union, 5/16" x 5/16"	8505X5**	1
12	tube, fuel return	20256	1
13	connector, tube, 5/16"t x 1/4"p	20501	1
14	bushing, reducing, 3/4" x 1/4"	C3109X12X4**	1
15	connector, tube, 5/16"t x 1/4"t	8205X5X4**	1
16	coupling, pipe 1/4"	3300X4**	1

* Standard hardware item, purchase locally.

** Weatherhead Co. part number.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

5.3 AIR INLET SYSTEM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5.3 AIR INLET SYSTEM

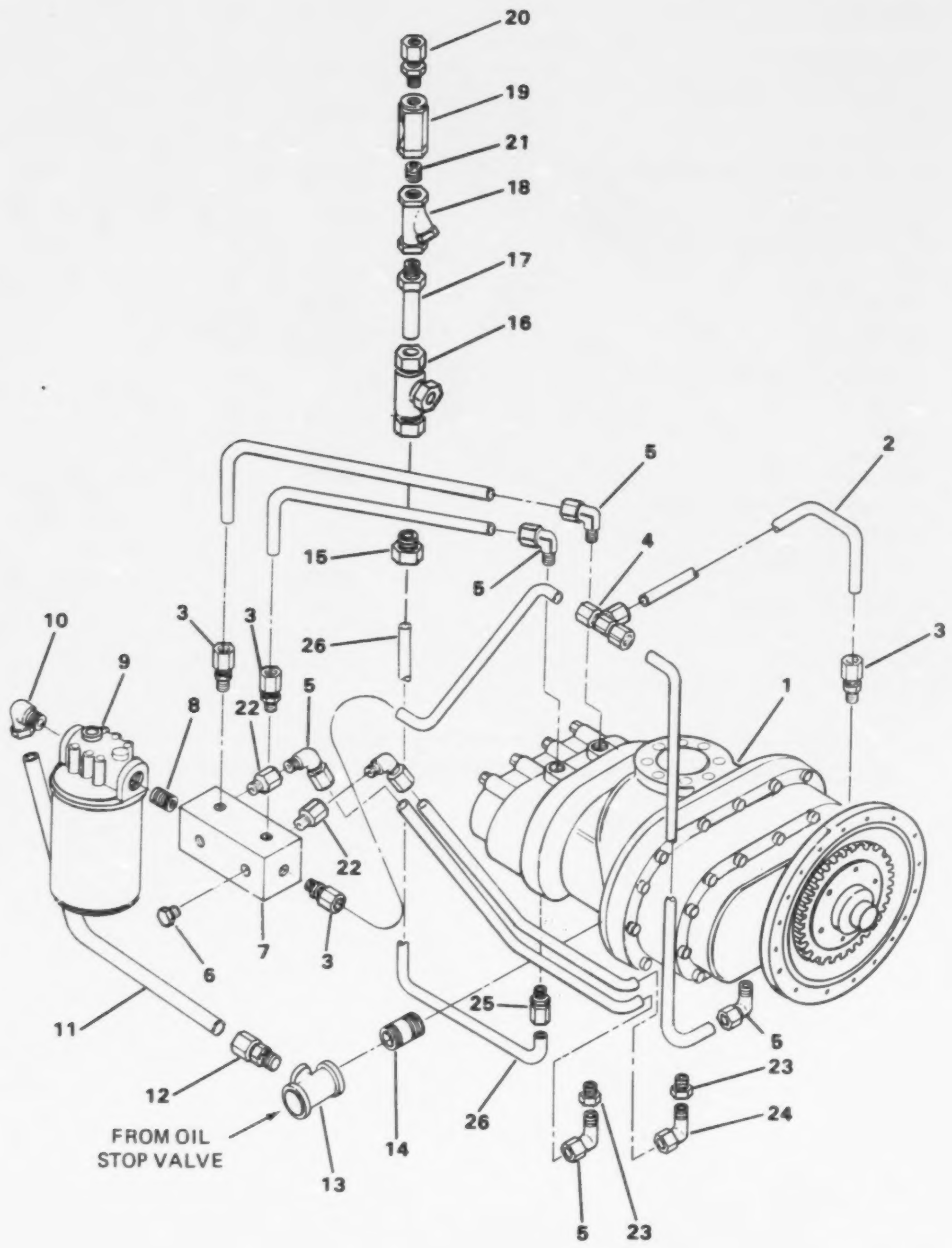
key no.	*description*	*part no.*	*qty.*
1	mounting band	41062	4
2	capscrew 5/16"-18nc x 1"	*	8
3	gasket	40364	8
4	nut, 5/16"-18nc	*	8
5	air cleaner assy (includes item 6 and 7)	46956	2
6	primary element	46968	2
7	safety element	46981	2
8	air cleaner indicator	45757	2
9	elbow	40303	2
10	clamp	40305	8
11	air tube	25100	1
12	duct, adapter	14094	1
13	capscrew, 1/2"-13nc x 2 1/2"	*	8
14	lockwasher, 1/2"	*	8
15	gasket	40696	2
16	inlet valve	40336	1
17	lever, inlet valve	20687	1
18	setscrew 5/16"-18nc x 3/8"	*	1
19	lockwasher	*	6
20	hose connector	40302	2
21	air tube	20287	1
22	engine inlet adapter	40363	1
23	capscrew, 3/8"-16nc x 1"	*	6
24	bracket, air filter	221579	1

* Standard hardware item, purchase locally.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

ILLUSTRATIONS AND PARTS LISTS

5.4 COMPRESSOR UNIT TUBING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5.4 COMPRESSOR UNIT TUBING

key no.	*description*	*part no.*	*qty.*
1	compressor unit	—	1
2	tubing, 3/8"	*	
3	connector, 3/8"t x 1/4"p	68X6***	7
4	tee, 3/8"	64X6***	1
5	elbow, 90°, 3/8"t x 1/4"p	69X6***	4
6	plug, 1/4"	*	1
7	adapter, oil flow	220945	1
8	nipple, close 3/4"	*	1
9	oil filter, bearing**	44415	1
10	elbow, 90°, tube 3/4"	69X12X12***	1
11	tubing, 3/4"	*	
12	connector, tube, 3/4"t x 3/4"p	68X12X12***	1
13	tee, reducing 1 1/4" x 1" x 3/4"	*	1
14	nipple, 1" x 3"	*	1
15	connector, reducing 1/4" x 1/2"t	68X6X8***	1
16	tee, 1/2"t x 1/2"p	72X8***	1
17	orifice	220956	1
18	strainer	41300	1
19	sight glass	46559	1
20	connector, 5/16"t x 1/4"p	68X5X4***	1
21	nipple, close 1/4"	*	1
22	connector, 1/4"t x 3/8"p	68X6***	2
23	reducer, 1/4"MPT x 1/8"FPT	220959	1
24	elbow, 90°, 3/8"t x 1/8"p	69X6X2***	1
25	connector, 1/2"t x 1/4"p	69X8X4***	1
26	tube, 1/2"	221084	1

* Standard hardware item, purchase locally.

** For filter element replacement order no. 44416.

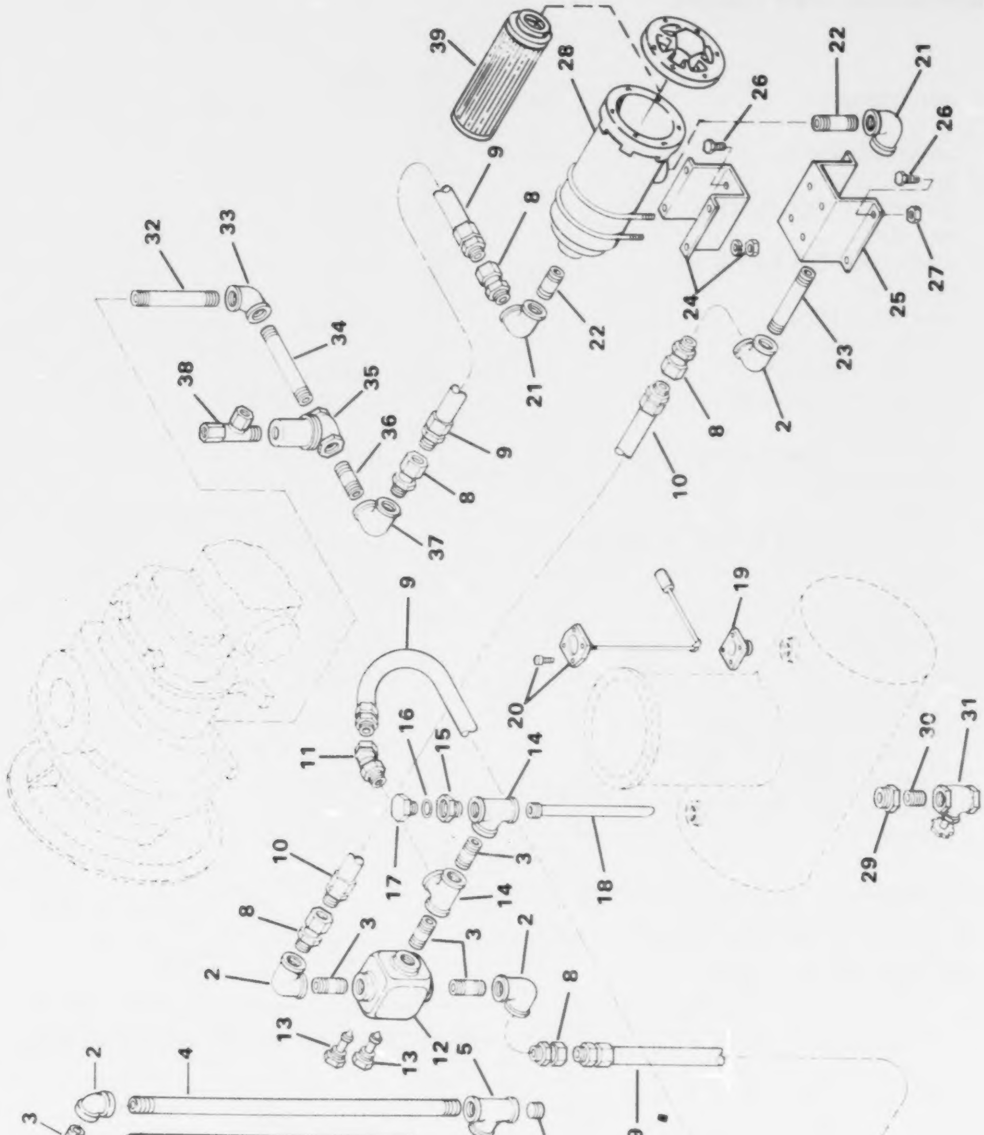
*** Weatherhead Co. part number.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5

ILLUSTRATIONS AND PARTS LISTS

5.5 COMPRESSOR COOLING AND LUBRICATION SYSTEM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5.5 COMPRESSOR COOLING AND LUBRICATION SYSTEM

key no.	*description*	*part no.*	*qty.*
1	cooler, oil	42170	1
2	elbow, pipe, 90°, 1 1/2"	*	5
3	nipple, pipe, 1 1/2" close	*	6
4	nipple, pipe, 1 1/2" x 52"	*	1
5	tee, reducing, 1 1/2" x 1/2" x 1 1/2"	*	2
6	plug, pipe 1/2"	*	2
7	nipple, pipe, 1 1/2" x 8 1/2"	*	1
8	adapter, swivel, 1 1/2"	40292	7
9	hose, hydraulic, 1 1/2" x 46" lg	41512	3
10	hose, hydraulic, 1 1/2" x 86" lg	40289	1
11	adapter, swivel, 45°, 1 1/2"	40382	1
12	housing, thermal valve	20382	1
13	element, thermal valve	44583	2
14	tee, pipe 1 1/2"	*	2
15	adapter, oil filler (includes item 16)	20044	1
16	o-ring	40102	1
17	cap, oil filler	40029	1
18	tube, oil pick up	20763	1
19	adapter, oil level gauge	40463	1
20	gauge, oil level	40374	1
21	elbow, reducing, 1 1/2" x 1 1/4"	*	2
22	nipple, close, 1 1/4"	*	2
23	nipple, pipe, 1 1/4" x 6" lg	*	1
24	bracket, filter mounting (includes hardware)	41014	1
25	bracket, oil filter	222047	1
26	capscrew, hex hd, 5/16"-18nc x 1"	*	14
27	nut, hex, 5/16"-18nc	*	14
28	filter, main oil **	46426	1
29	bushing, reducing, 1 1/2" x 1/2"	*	1
30	nipple, close, 1/2"	*	1
31	valve, gate, 1/2"	41574	1
32	nipple, pipe, 2 1/2" x 6"	*	1
33	elbow, reducing, 2 1/2" x 2"	*	1
34	nipple, pipe, 2" × 4"	*	1
35	valve, oil stop **	14098	1
36	nipple, close 2"	*	1
37	elbow, reducing, 2" × 1½"	*	1
38	tee, male run tube, 1 1/4"t x 1/4"p	*	1
39	element, main filter***	46428	1

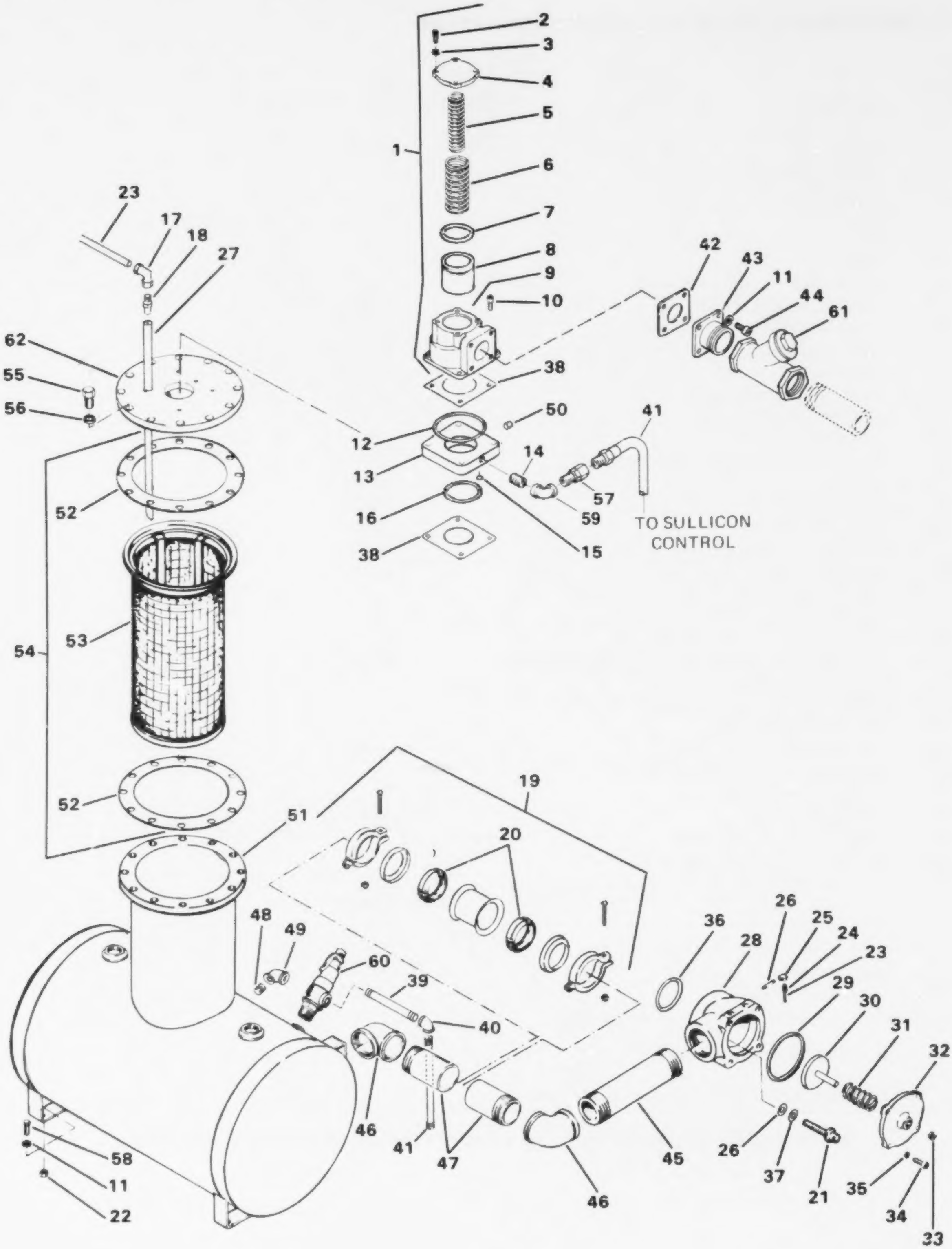
* Standard hardware item, purchase locally.

** Repair kit for oil stop valve 14098 is 1109.

*** For main element gasket kit order No. 46430.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5
ILLUSTRATIONS AND PARTS LISTS
5.6 COMPRESSOR DISCHARGE SYSTEM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5.6 COMPRESSOR DISCHARGE SYSTEM

key no.	*description*	*part no.*	*qty.*
1	minimum pressure valve (includes items 2 thru 9)	11054	1
2	capscrew, ferry, 1/2"-13nc x 1 1/2"	•	4
3	lockwasher, 1/2"	•	4
4	cover	20291	1
5	spring, inner	40633	1
6	spring, outer	40272	1
7	ring, seal	40271	1
8	piston	20290	1
9	housing	20289	1
10	capscrew, socket head, nylock 1/2"-13nc x 3"	•	4
11	lockwasher, 1/2"	•	11
■ 12	o-ring	826502-259**	1
13	adapter, valve	20619	1
14	nipple, pipe, 3/4" close	•	1
15	o-ring	MS29513-113**	1
■ 16	o-ring	826502-244**	1
17	elbow, flexible, 5/16"t	•	1
18	fitting, oil return	20501	1
19	coupling, flexmaster	40327	1
20	ring, coupling	40523	2
21	capscrew, 3/8"-16nc x 2 1/2"	•	4
22	nut, 1/2"-13nc	•	7
23	tubing, steel 1/4"	•	11
24	connector, 1/4"t x 1/8"p	•	3
25	elbow, tube, 1/4"t x 1/8"p	•	1
26	washer, sealing	240047	1
27	tube, oil return	25604	1
28	housing, discharge valve	26494	1
■ 29	o-ring	826502-259**	1
30	plunger, valve	12894	1
31	spring, valve	40263	1
32	cover	20278	1
33	plug, pipe, 3/4"	•	1
34	capscrew, ferry 1/2"-13nc x 1 1/2"	•	4
35	lockwasher, 1/2"	•	4
■ 36	o-ring	826502-240**	1
37	washer, back up	220035	4
38	gasket min. pressure valve	49202	2
39	nipple, pipe, 1 1/2" x 8"	•	1
40	elbow, pipe, 90°, 1 1/2"	•	1

(continued on next page)

• Standard hardware item, purchase locally.

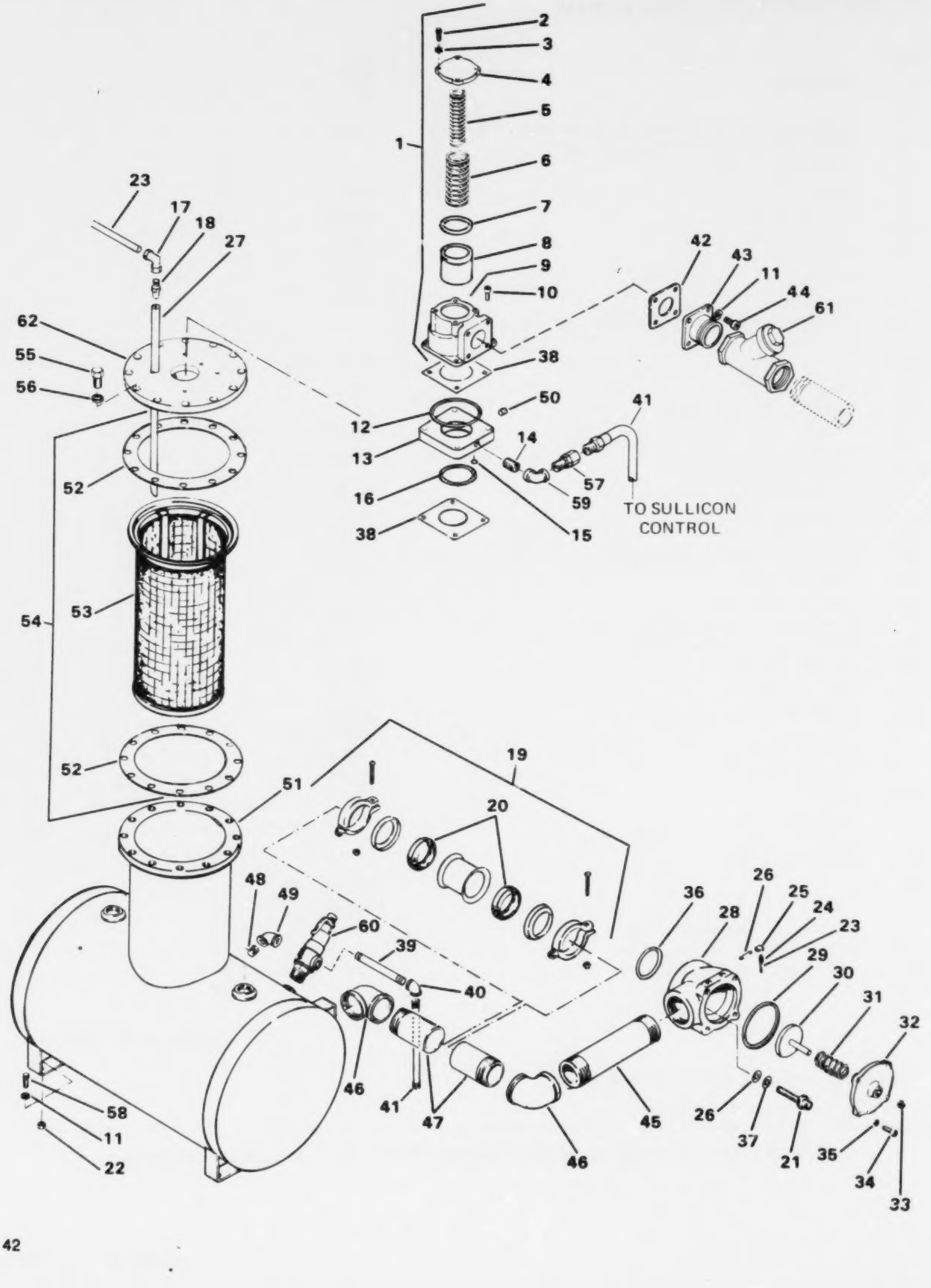
•• Military Standards part number.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5

ILLUSTRATIONS AND PARTS LISTS

5.6 COMPRESSOR DISCHARGE SYSTEM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5.6 COMPRESSOR DISCHARGE SYSTEM continued

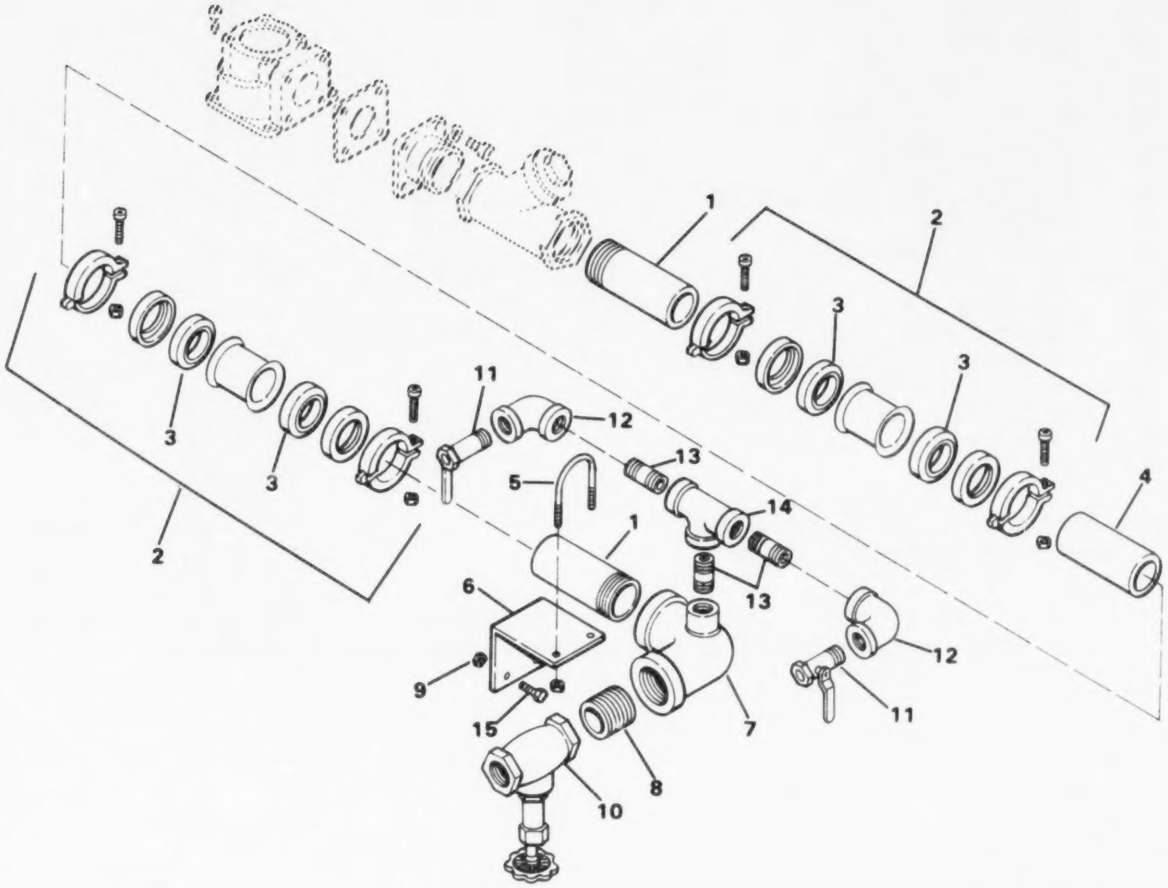
key no.	*description*	*part no.*	*qty.*
41	nipple, pipe, 1 1/2" x 13"	*	1
42	gasket, flange	40462	1
43	flange, discharge	11142	1
44	capscrew, 1/2"-13nc x 1 1/2"	*	4
45	nipple, pipe, 3" x 8 1/2"	*	1
46	elbow, pipe, 3"	*	2
47	nipple, half, 3" × 7½"	*	2
48	nipple, close, 1/4"	*	1
49	elbow, pipe, 90°, 1/4"	*	1
50	plug, pipe, 1/8"	*	1
51	air receiver, oil sump	40265	1
52	gasket, separator (included in 54)	45765	2
53	separator assy	40259	1
54	element kit, separator **	11399	1
55	bolt, cover	828212-250	12
56	lockwasher, 3/4"	*	12
57	adapter, swivel	40148	1
58	capscrew, hex hd, 1/2"-13nc x 1 1/4"	*	4
59	elbow, pipe, 90°, 3/4"	*	1
60	valve, pressure relief	40276	1
61	check valve	42047	1
62	cover, separator	20280	1

* Standard hardware item, purchase locally.

** Element kit contains items 52 and 53.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

5.6.1 COMPRESSOR DISCHARGE SYSTEM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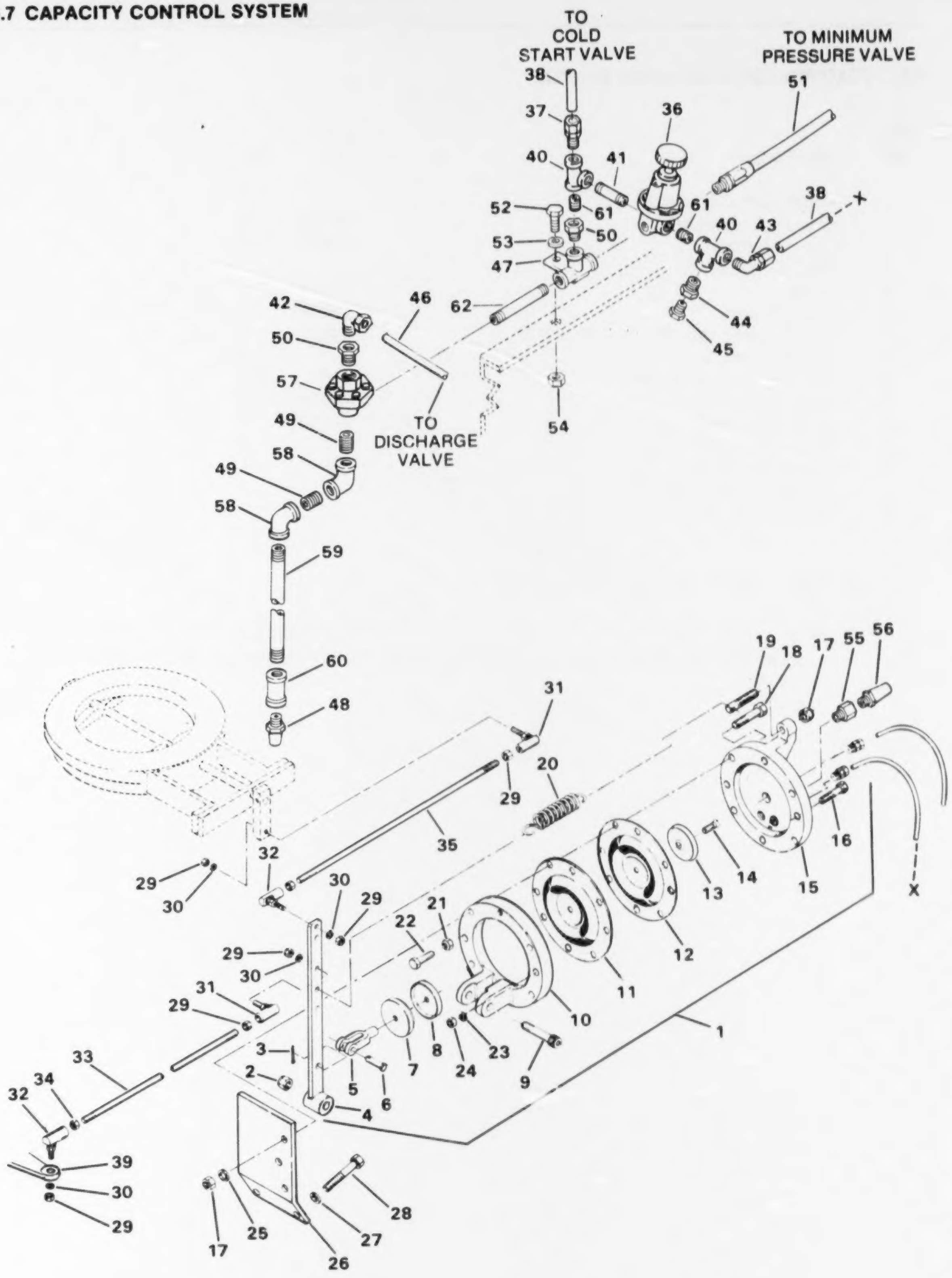
5.6.1 COMPRESSOR DISCHARGE SYSTEM

key no.	*description*	*part no.*	*qty.*
1	nipple, half, 2½" × 12½"	*	2
2	coupling, flexmaster	40648	2
3	ring, coupling	40649	4
4	pipe, 2 1/2" x 10"	*	1
5	U-bolt	43713	1
6	support, pipe	222581	1
7	elbow, side outlet, 3" x 2 1/2" x 3/4"	14329	1
8	nipple, close, 3"	*	1
9	nut, whizlock, 5/16"-18nc	*	2
10	valve, discharge	40804	1
11	valve, discharge	40030	2
12	elbow, pipe, 3/4"	*	3
13	nipple, close, 3/4"	*	1
14	tee, pipe, 3/4"	*	1
15	screw, 5/16"-18nc x 1"	*	2

* Standard hardware item, purchase locally.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

5.7 CAPACITY CONTROL SYSTEM


TO COLD START VALVE
TO MINIMUM PRESSURE VALVE
TO DISCHARGE VALVE
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5.7 CAPACITY CONTROL SYSTEM

key no.	*description*	*part no.*	*qty.*
1	sullicon control (includes items 2 thru 25) ***	11889	1
2	nut, self-locking, 5/16"-18nc	*	1
3	cotter pin, 1/16" x 1/2"	*	1
4	lever	11084	1
5	yoke	40138	1
6	yoke pin	40065	1
7	plunger	20094	1
8	cup, seal	42538	1
9	socket hd shoulder screw	*	1
10	body	21635	1
11	diaphragm, external	41269	1
12	diaphragm, internal	41270	1
13	washer, back up	21172	1
14	screw, special sealing	41264	1
15	cover	26168	1
16	capscrew, 5/16"-18nc x 2 1/2"	*	3
17	nut, 3/18"-16nc	*	6
18	capscrew, 3/8"-16nc x 2 1/2"	*	4
19	screw, spring adjust	21636	1
20	spring	41273	1
21	nut, 5/16"-24nf	*	1
22	machine screw, 5/16"-24nf x 2"	*	1
23	lockwasher, 5/16"	*	3
24	nut, 5/16"-18nc	*	3
25	lockwasher, 3/8"	*	4
26	bracket, control	12080	1
27	lockwasher, 3/8"	*	2
28	capscrew, 3/8"-24nf x 4"	*	2
29	nut, jam, 1/4"-28nf, r.h.	*	6
30	lockwasher, 5/16"	*	4
31	joint, ball, 5/16"-24nf, r.h.	40294	2
32	joint, ball, 5/16"-24nf, l.h.	40295	2
33	rod, control engine	20281	1
34	nut, jam, 1/4"-28nf, l.h.	*	2
35	rod, control, compressor	12482	1
36	pressure regulator **	43401	1
37	connector, flex, 1/4"p x 5/16"t	*	3
38	tubing, steel, 5/16"	*	8
39	lever, governor	42160	1
40	tee, 1/4"	*	2

(continued on next page)

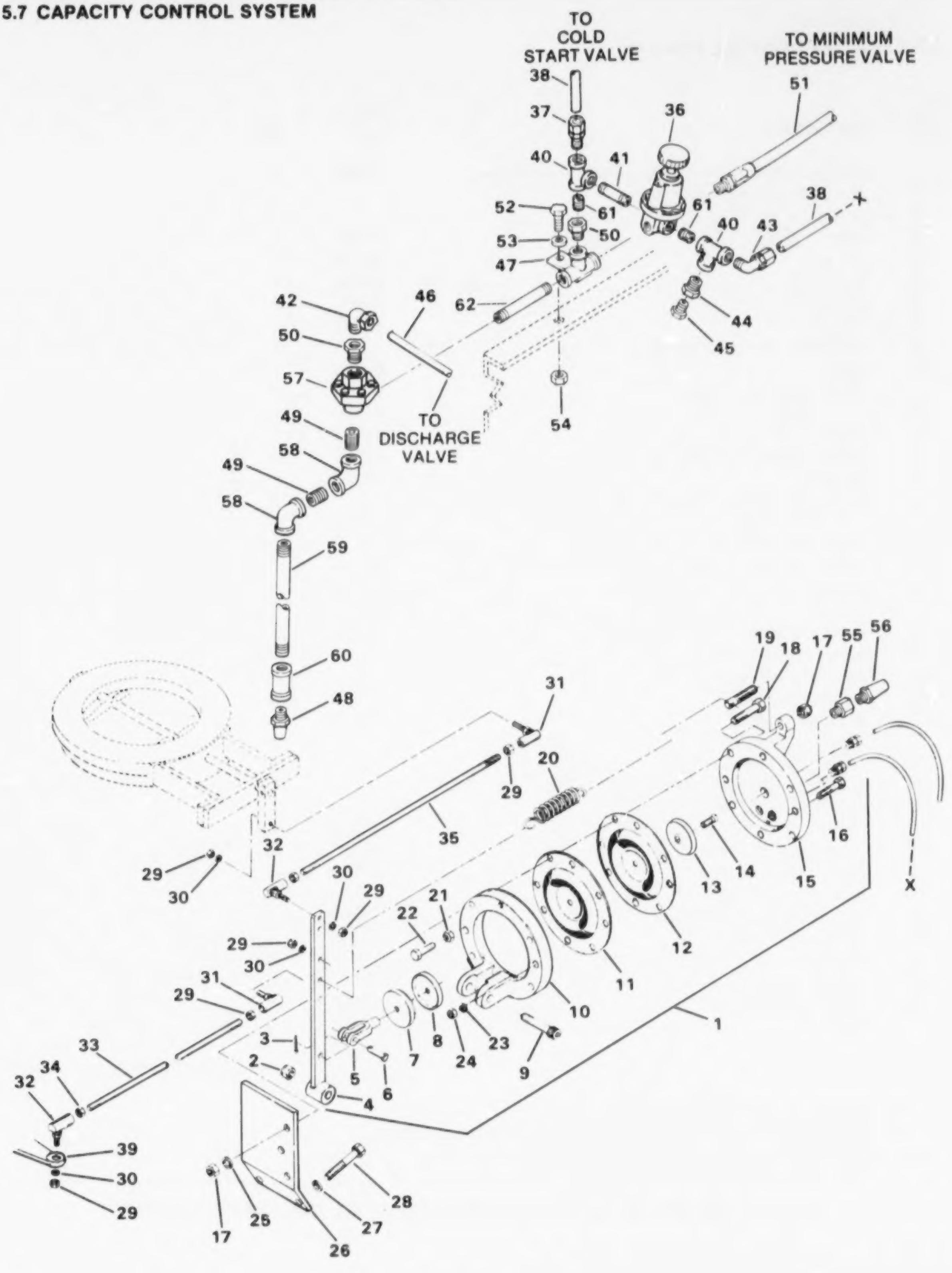
* Standard hardware item, purchase locally.

** For repair kit, pressure regulator, order Sullair Part No. 12548.

*** For repair kit, Sullicon control, order Sullair Part No. 11579

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

5.7 CAPACITY CONTROL SYSTEM


TO COLD START VALVE
TO MINIMUM PRESSURE VALVE
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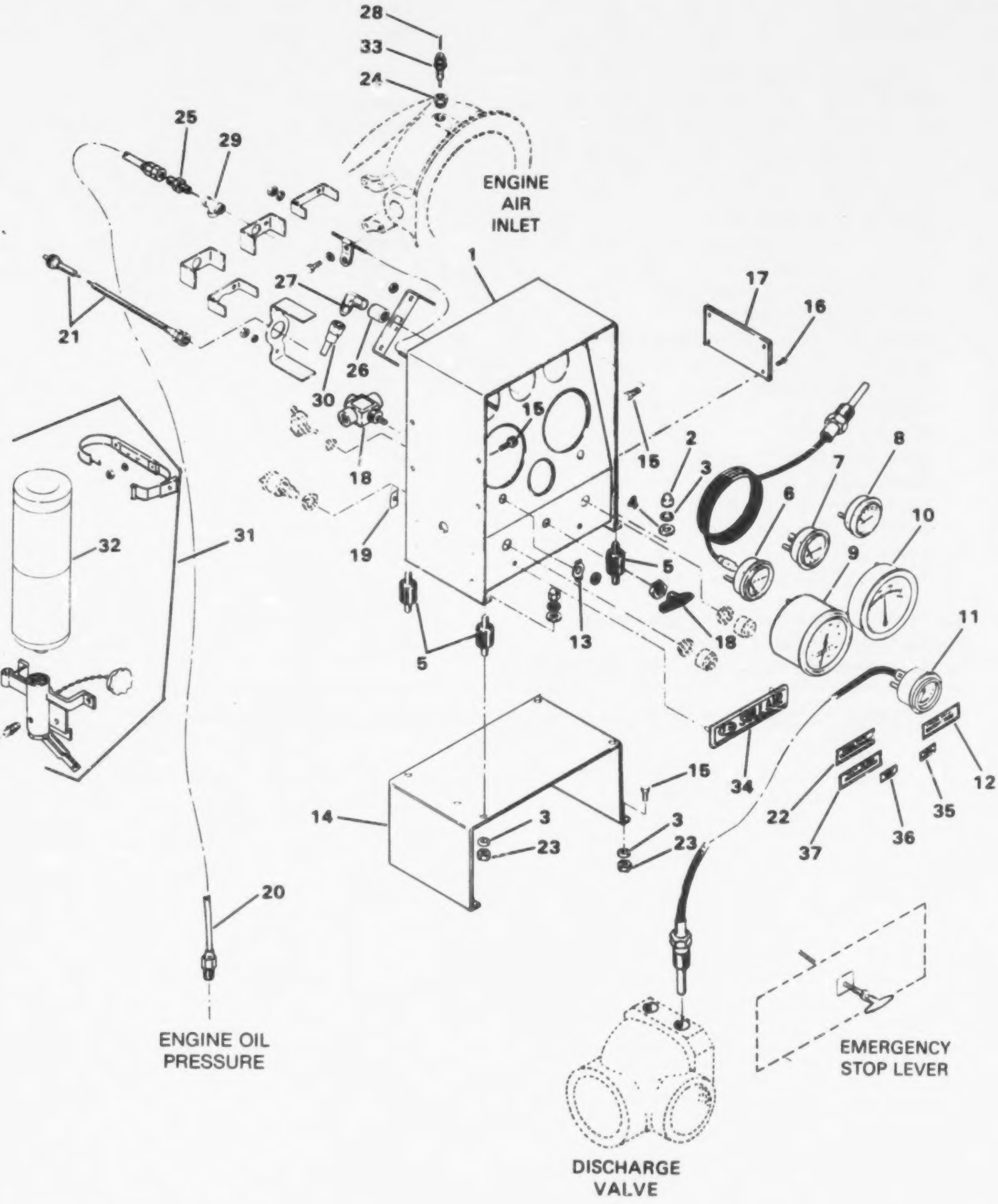
5.7 CAPACITY CONTROL SYSTEM continued

key no.	*description*	*part no.*	*qty.*
41	nipple, pipe, 1/4"p x 2"	*	1
42	elbow, tube, 1/4"t x 1/4"p	7405X4X4**	1
43	elbow, tube, 5/16"t x 1/4"p	7405X5X4**	1
44	bushing, pipe, 1/2" x 1/8"	*	1
45	valve, drain	41111	1
46	tubing, steel, 1/4"	*	1
47	support, blowdown valve	11083	1
48	silencer, blowdown valve	43169	1
49	nipple, close, 3/4"	*	3
50	bushing, reducing, 3/4" x 1/4"	*	2
51	hose, hydraulic, 3/4" x 46"	40397	1
52	capscrew, hex hd 1/2"-13nc x 1 1/4"	*	1
53	lockwasher, 1/2"	*	1
54	nut, hex, 1/2"-13nc	*	1
55	orifice	26367	1
56	silencer	44916	1
57	valve, blowdown***	40278	1
58	elbow, pipe, 3/4"	*	1
59	nipple, pipe, 3/4" x 19" lg	*	1
60	coupling, pipe, 3/4"	*	1
61	nipple, close, ¼"	*	2
62	nipple, pipe, ¾" × 8"	*	1

* Standard hardware item, purchase locally.
** Weatherhead Co. part number.
*** For replacement to diaphragm order no. 40273.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5
ILLUSTRATIONS AND PARTS LISTS
5.8 INSTRUMENT PANEL AND PARTS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ENGINE OIL
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STOP LEVER
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VALVE

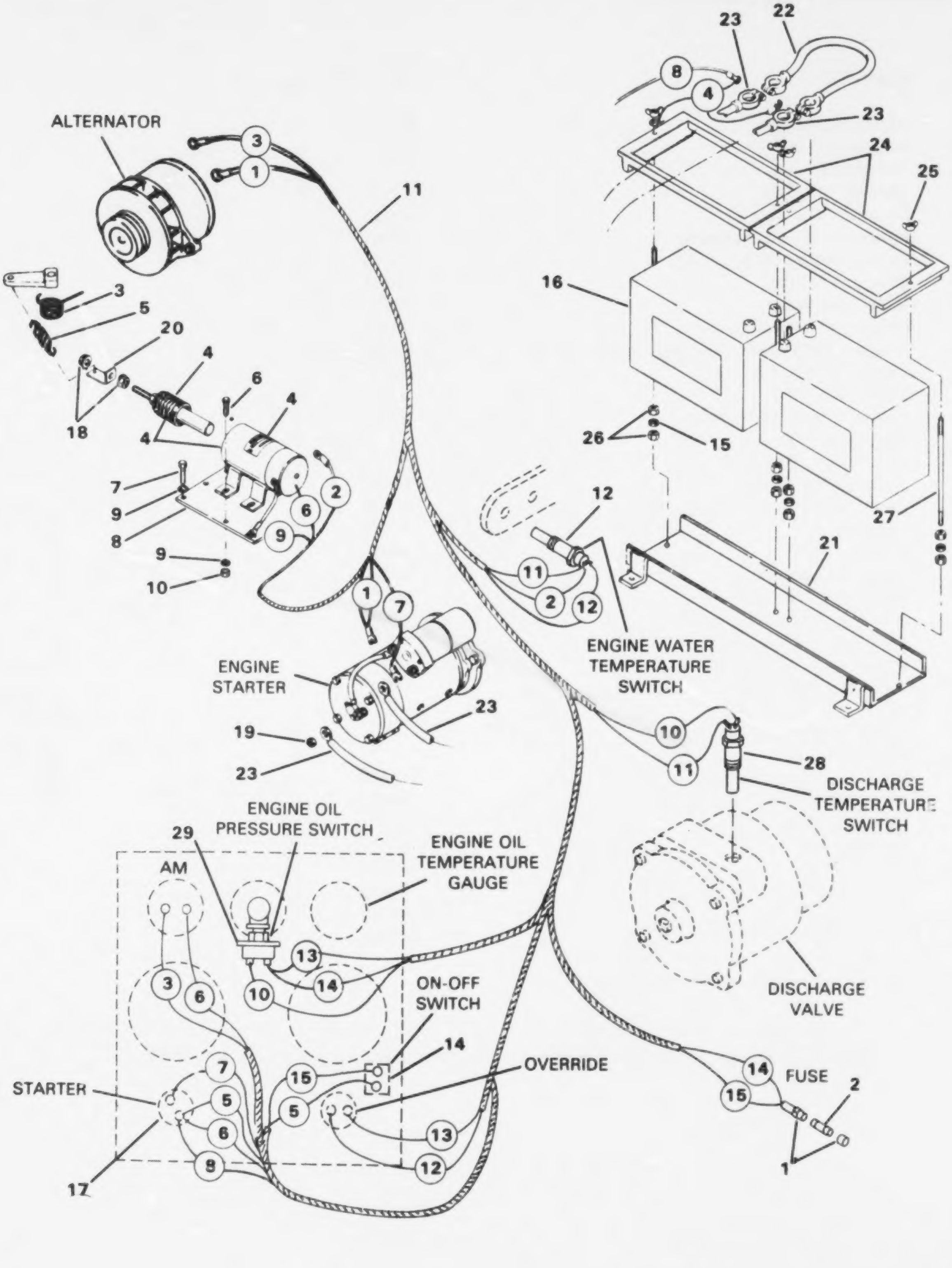
5.8 INSTRUMENT PANEL AND PARTS

key no.	*description*	*part no.*	*qty.*
1	panel, instrument	11072	1
2	nut, acorn, 1/4"	*	4
3	lockwasher, 1/4"	*	17
4	washer, flat, 1/4"	*	4
5	isolator, vibration	40091	4
6	gauge, engine temperature	40311	1
7	gauge, engine oil pressure	40310	1
8	gauge, ammeter	46234	1
9	tach, hourmeter	40307	1
10	gauge, receiver pressure	40313	1
11	gauge, compressor discharge temperature	40441	1
12	decal, "STARTER"	40558	1
13	plate, "ON-OFF"	40607	1
14	bracket, instrument panel	221561	1
15	capscrew, 1/4"-20nc x 3/4"	*	9
16	rivet pop, 1/8" x 3/8"	*	4
17	plate, serial number	40052	1
18	valve, cold start	44205	1
19	fastener	41516	2
20	hose	40411	1
21	cable, tachometer	49300	1
22	decal, engine switch	40559	1
23	nut, 1/4"-20nc	*	13
24	bushing, reducing, 1/4" x 1/8"	*	1
25	connector, 1/4" x 1/8"	*	1
26	coupling, pipe, 1/4"	*	1
27	elbow, flare, 1/4" x 1/4"	*	1
28	tubing, copper, 1/8"	*	10
29	tee, pipe, 1/8"	*	2
30	hose, receiver pressure	40396	1
31	kit, ether start	40348	1
32	cylinder, ether	40505	1
33	nozzle, ether	40747	1
34	plate, name	41043	1
35	decal, "RUN"	44210	1
36	decal, "START"	44209	1
37	decal, "SAFETY OVERRIDE"	42585	1

* Standard hardware item, purchase locally.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5
ILLUSTRATIONS AND PARTS LISTS
5.9 ELECTRICAL PARTS



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5.9 ELECTRICAL PARTS

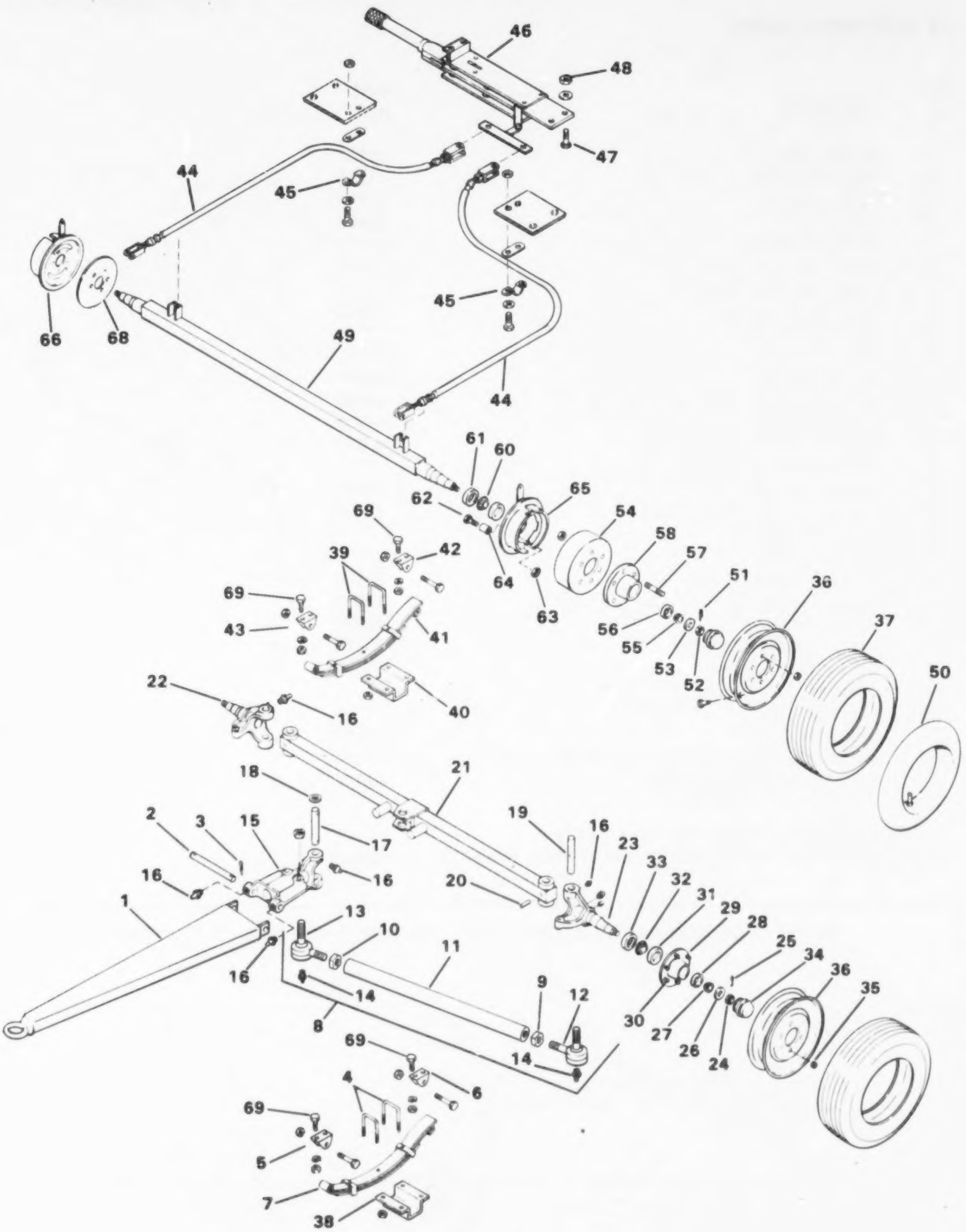
key no.	*description*	*part no.*	*qty.*
1	holder, fuse	41304	1
2	fuse, 6.25 amp	41305	1
3	spring, return	41769	1
4	solenoid **	40457	1
5	spring, extension	41770	1
6	capscrew, 1/4"-20nc x 3/4"	*	4
7	capscrew, 1/4"-20nc x 1"	*	4
8	bracket, solenoid	20390	1
9	lockwasher, 1/4"	*	4
10	nut, 1/4"-20nc	*	4
11	wiring harness	49287	1
12	switch, engine water temperature	40653	1
13	valve, cold start	44205	1
14	switch, on-off	40037	1
15	lockwasher, 3/8"	*	4
16	battery, 12 volt	40161	2
17	switch, starter and by pass	40038	2
18	nut, 5/16"-18nc	*	2
19	nut, 1/2"-13nc	*	2
20	bracket, spring	22170	1
21	support, battery	11858	1
22	cable, battery	40318	1
23	cable, battery to starter	40317	2
24	hold-down, battery	11032	2
25	nut, wing, 3/8"-16nc	*	4
26	nut, 3/8"-16nc	*	8
27	rod, hold-down	20130	2
28	switch, compressor discharge temperature	43374	1
29	switch, engine oil pressure	40434	1

* Standard hardware item, purchase locally.

** For replacement rubber boot only only order Sullair part number 43506.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5
ILLUSTRATIONS AND PARTS LISTS
5.10 RUNNING GEAR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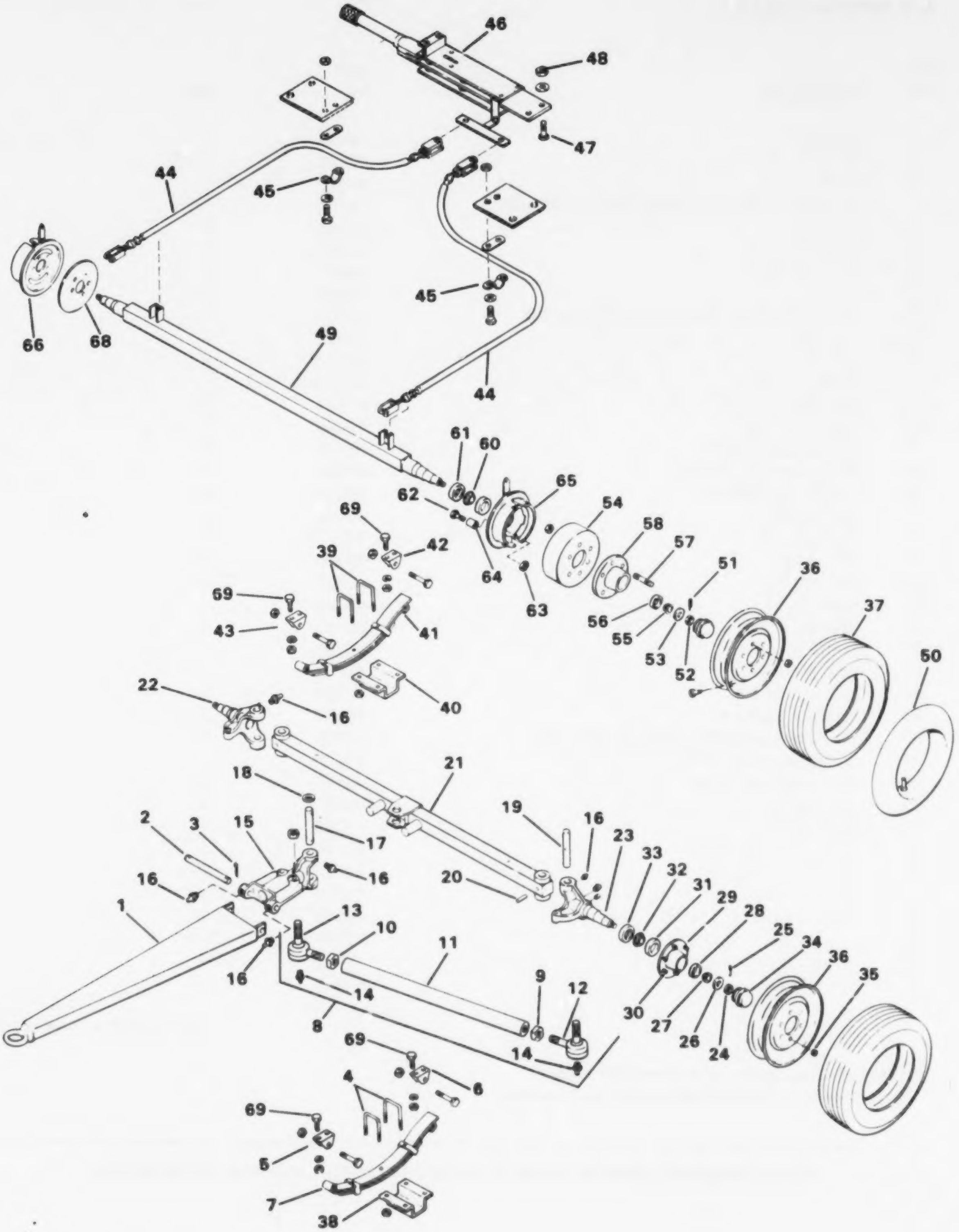
5.10 RUNNING GEAR

key no.	*description*	*part no.*	*qty.*
1	drawbar	14178	1
2	drawbar pin	49529	1
3	cotter pin	49530	2
	axle assy, front (includes items 4 thru 35)	14176	1
4	U-bolt	49508	8
5	bracket assy	49490	2
6	bracket assy	49491	2
7	spring	49506	2
8	tie rod assy (includes items 9 thru 13)	14508	2
9	nut, jam	4605-1**	2
10	nut, jam	4605-2**	2
11	tube, tie rod	3902-256**	2
12	ball joint, l.h.	49587	2
13	ball joint, r.h.	49588	2
14	fitting, lubrication	49505	4
15	arm, steering, center	49498	1
16	fitting, lubrication	49503	8
17	pin, center	49496	1
18	washer, flat	4701-9*	1
19	pin, king	49496	2
20	pin, spring	49497	2
21	axle, front	49493	1
22	spindle, r.h.	49495	1
23	spindle, l.h.	49494	1
24	nut, spindle	49501	2
25	pin, cotter	49502	2
26	washer, spindle	49500	2
	hub assy (includes items 27 thru 33)	14505	2
27	cone, bearing, outer	49593	2
28	cup, bearing, outer	49591	2
29	hub, wheel	3624**	2
30	stud, wheel	49589	12
31	cup, bearing, inner	49590	2
32	cone, bearing, inner	49592	2
33	seal, grease	49594	2
34	cap, grease	49595	2
35	nut, wheel	49596	12
36	wheel, trailer	49492	4
37	tire, trailer	49538	4

(continued on next page)

* Standard hardware item, purchase locally.
** Indicates Prototype Development part number.

Section 5
ILLUSTRATIONS AND PARTS LISTS
5.10 RUNNING GEAR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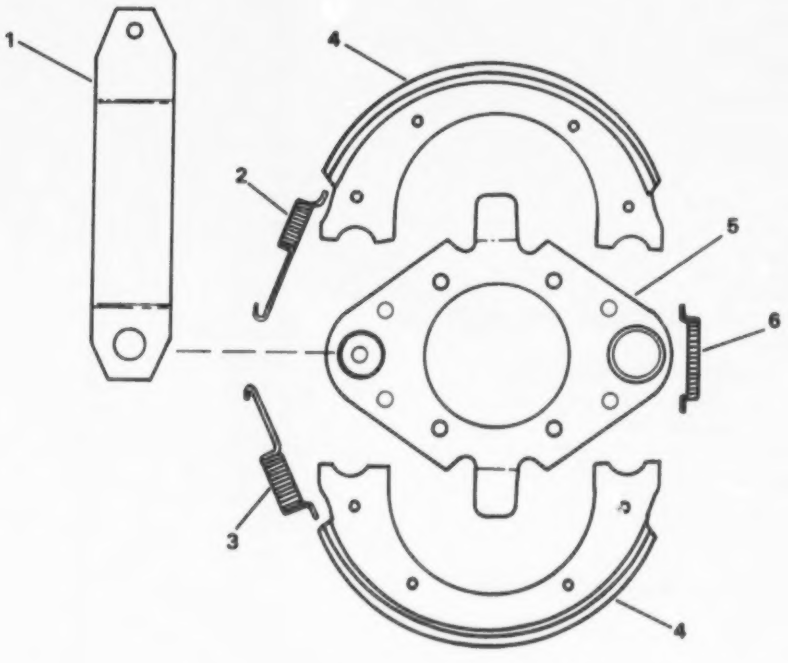
5.10 RUNNING GEAR continued

key no.	*description*	*part no.*	*qty.*
38	clamp, axle	49507	2
	axle assembly, rear (includes items 39 thru 67)	14177	1
39	U-bolt	49508	4
40	clamp, axle	49507	3
41	spring	49506	2
42	bracket assy	49490	2
43	bracket assy	49491	2
44	cable assy, brake	241125**	2
45	clamp, cable	241136**	2
46	lever, hand brake	49531	1
47	capscrew	4901-7**	4
48	nut, locking	4601-11**	4
49	axle rear	49511	1
50	tube, tire	40355	4
51	pin, cotter	49502	2
52	nut, spindle	49501	2
53	washer, spindle	49500	2
	hub and drum assy (includes items 54 thru 61)	14506	2
54	drum, brake	8240-17**	2
	hub assy (includes items 55 thru 61)	49504	2
55	cone, bearing, outer	49593	2
56	cup, bearing, outer	49591	2
57	stud, wheel	49589	12
58	hub, wheel	3624**	2
59	cup, bearing, inner	49450	2
60	cone, bearing, inner	49592	2
61	seal, grease	49594	2
	brake assy (includes items 62 thru 66)	14507	2
62	bolt, mounting	4900-13**	10
63	nut, mounting	4601-7**	10
64	spacer	4337-4**	10
65	brake, l.h.	49597	1
66	brake, r.h.	49598	1
67	capscrew, 1/2"-13nc x 1 1/2"	*	16
68	shield, dirt	8240-15**	2

* Standard hardware item, purchase locally.
** Indicates Prototype Development part number.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

5.11 BRAKES



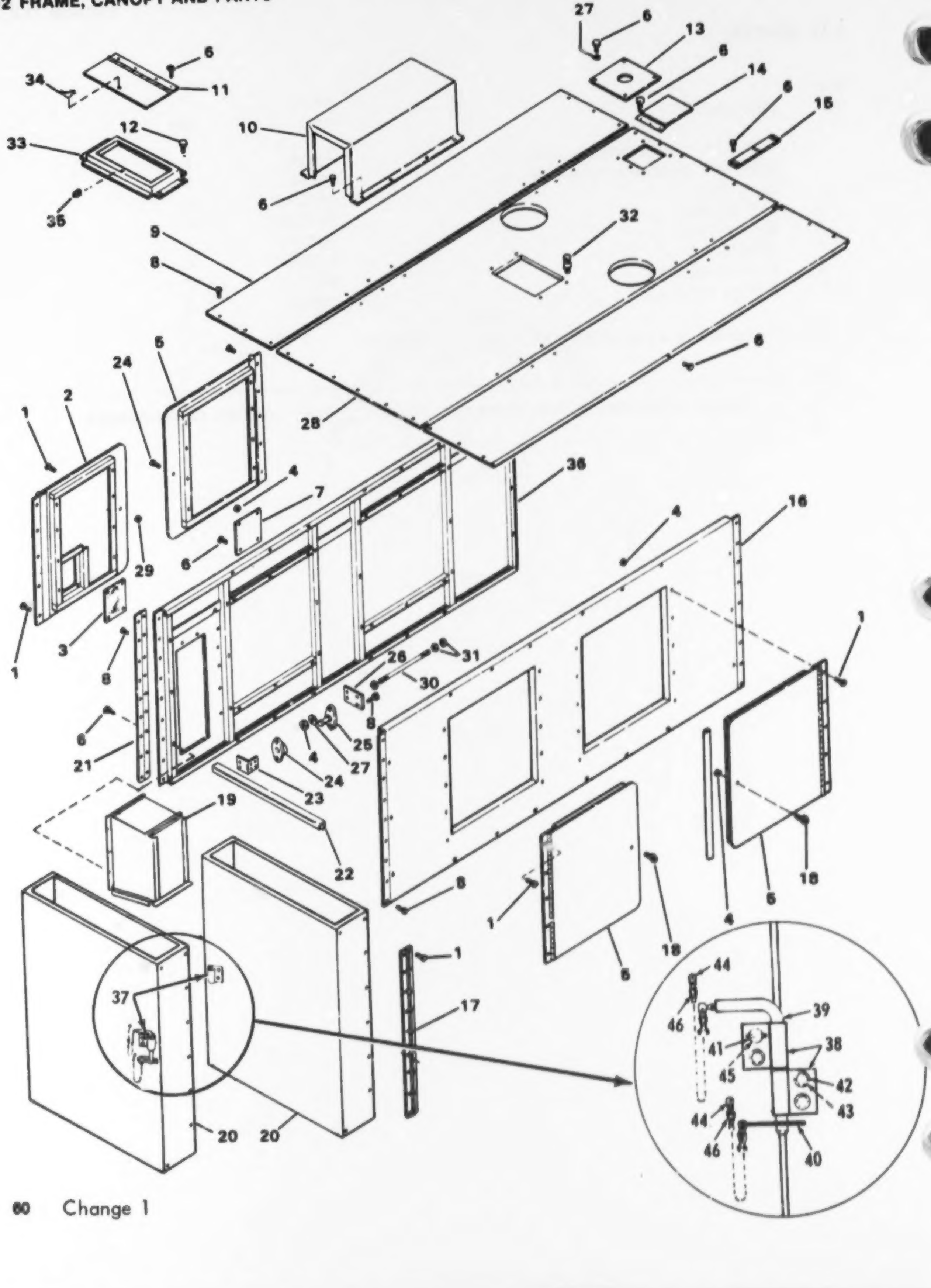
5.11 BRAKES

key no.	*description*	*part no.*	*qty.*
	brake, l.h. (includes items 1 thru 6)	49597	1
	brake, r.h. (includes items 1 thru 6)	49598	1
1	lever, brake	8240-13*	1
2	spring, return	3203360*	1
3	spring, return	308664*	1
4	shoe, brake	4150084*	2
5	plate, mounting	308743*	1
6	spring, brake	308665*	1

* Indicates Bendix Brake and Steering Division part number.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINES

5.12 FRAME, CANOPY AND PARTS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5.12 FRAME, CANOPY AND PARTS

key no.	description	part no.	qty
1	capscrew, carriage hd, 5/16" x 3/4"	*	54
2	door, hinged	13980	1
3	plexiglass	220939	1
4	nut, 5/16"-18nc	*	48
5	door, hinged	13979	3
6	screw, self-tapping 1/4" x 3/4"	*	72
7	cover, right hand	220744	1
8	capscrew, hex hd 5/16"-18nc x 3/4"	*	48
9	top, hood side	13974	2
10	cover, muffler	14164	2
11	cover, lifting bail	14244	1
12	capscrew	*	12
13	cover, muffler hole	220742	2
14	cover, radiator filler	13965	1
15	panel, backing	221582	4
16	panel, housing side	13964	1
17	hinge, right hand	47842	1
18	eyebolt, 5/16"-18nc x 1"	*	4
19	box, recessed service valve	14303	1
20	duct, air inlet	14382	2
21	hinge, left hand	47841	1
22	angle, support	220810	1
23	angle, door holder	221602	2
24	socket, door holder	42069	2
25	plunger, door holder	42067	2
26	plate, door holder	221601	2
27	washer, flat, 1/4"	*	12
28	top, hood, center	13973	1
29	grommet, rubber	40125	8
30	rod	222043	2
31	nut, 3/8"-16nc	*	8
32	jacknut, 1/4" (molly type)	*	12
33	base, lifting bail cover	22239	1
34	nut, wing, 5/16"-18nc	*	1
35	clip, retaining, 5/16"-18nc	*	1
36	panel, housing side, discharge	14302	1
37	kit, inlet duct latch	1169	1
38	guide, door latch pin	15278	2
39	pin assembly, door latch	15277	1
40	pin, cotter, spring	245778	1

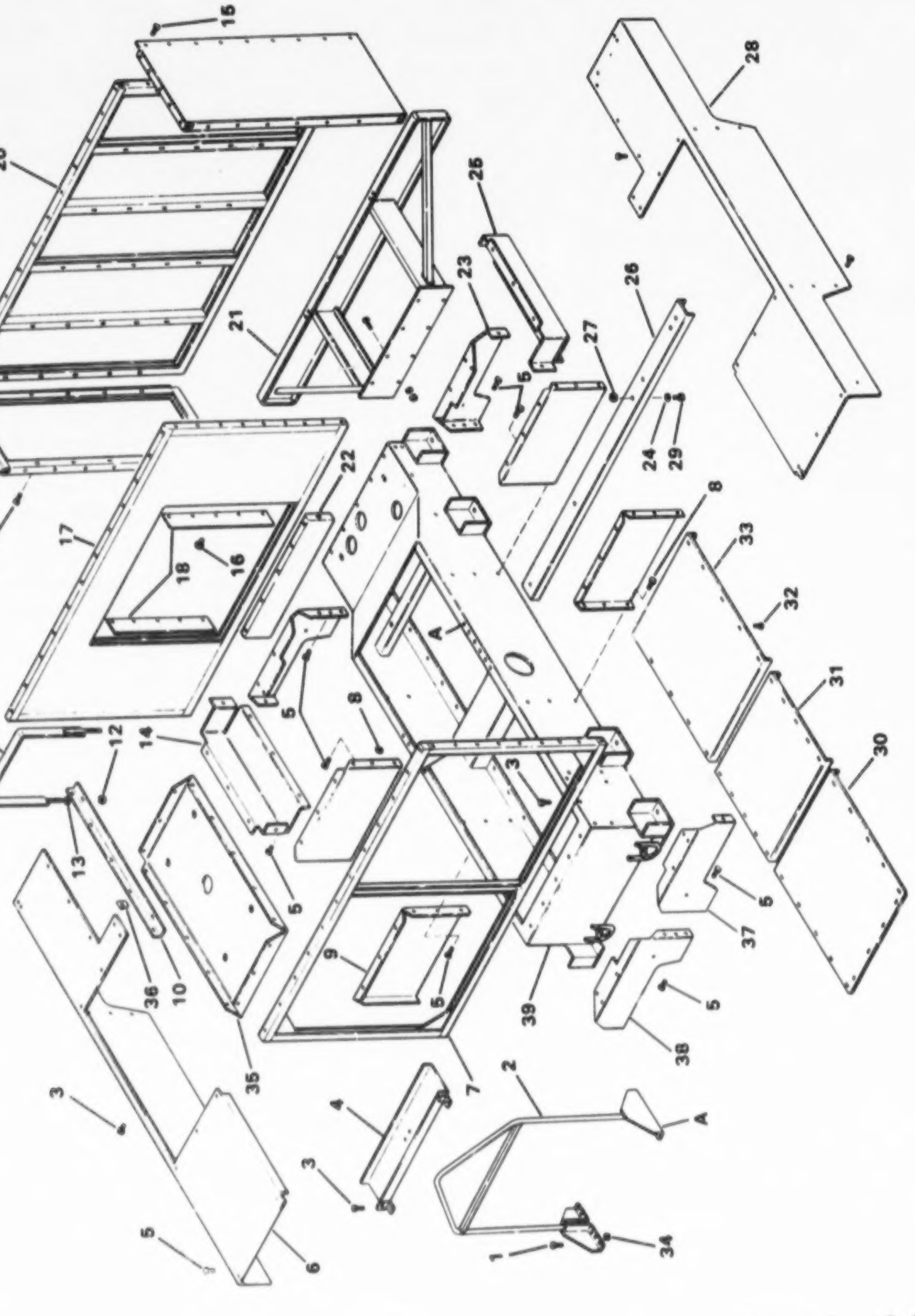
Cont'd key no.	description	part no.	qty
41	screw, thumb, padlock	225937	1
42	screw, hex, 5/16 x 3/4	829705-075	3
43	nut, hex, 5/16-18	825305-283	3
44	rivet, pop, 1/8 x 3/8	843102-038	2
45	nut, locking 3/8-16	825506-198	1
46	chain, sash	245780	2

* Standard hardware item, purchase locally.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

ILLUSTRATIONS AND PARTS LISTS

5.13 FRAME, CANOPY AND PARTS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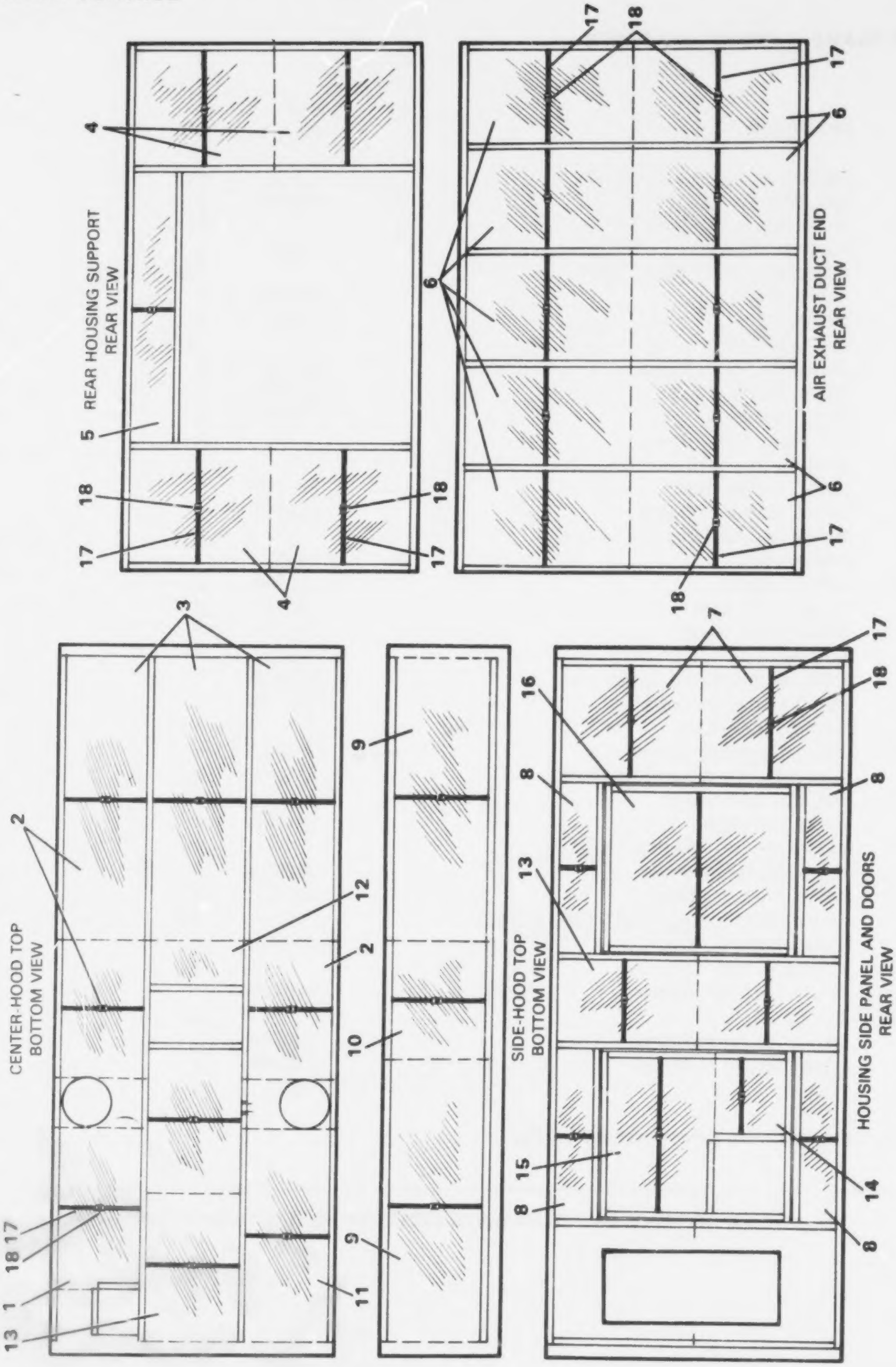
5.13 FRAME, CANOPY AND PARTS

key no.	*description*	*part no.*	*qty.*
1	capscrew, 1/2"-13nc x 1 1/2"	*	12
2	bail, lifting	12973	1
3	capscrew, 5/16"-18nc x 1"	*	22
4	support battery	11858	1
5	capscrew, 5/16"-18nc x 3/4"	*	198
6	fender, r.h.	220731	1
7	frame, front	13959	1
8	nut, 5/16"-18nc	*	182
9	panel, fender to frame	220747	4
10	angle, brace, fender	221580	1
11	strap, fuel tank	14189	2
12	nut, lock, 5/16"-18nc	*	4
13	washer, flat, 5/16"	*	4
14	panel, fender, rear	220726	1
15	panel, fender to frame	220749	1
16	screw, self-tapping, 1/4" x 3/4"	*	8
17	frame, rear	13957	1
18	baffle, rubber	222044	2
19	panel, duct, side	13972	2
20	panel, duct, front	13971	1
21	bumper	14086	1
22	frame and housing, lower rear	222045	1
23	panel fender to frame	220748	1
24	washer, lock, 3/4"	*	12
25	panel, fender to frame	220727	1
26	support, receiver and fuel tank	221614	2
27	nut, hex 3/4"-10nc	*	12
28	fender, left hand	220730	1
29	capscrew, 3/4"-10nc x 1 1/2"	*	12
30	cover, bottom front	220938	1
31	cover, bottom center	220937	1
32	screw, self tapping, 5/16"-18nc x 3/4"	*	34
33	cover, bottom, rear	220936	1
34	nut, lock, 1/2"-13nc	*	12
35	cover, receiver, bottom	220746	1
36	clip nut, 5/16"	*	38
37	panel, fender to frame	220749	1
38	panel, fender to frame	220748	1
39	frame	12951	1

* Standard hardware item, purchase locally.

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

Section 5
ILLUSTRATIONS AND PARTS LISTS
5.14 SOUND CONTROL


REAR HOUSING SUPPORT
REAR VIEW
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AIR EXHAUST DUCT END
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CENTER-HOOD TOP
BOTTOM VIEW
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SIDE-HOOD TOP
BOTTOM VIEW
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HOUSING SIDE PANEL AND DOORS
REAR VIEW
CURB SIDE
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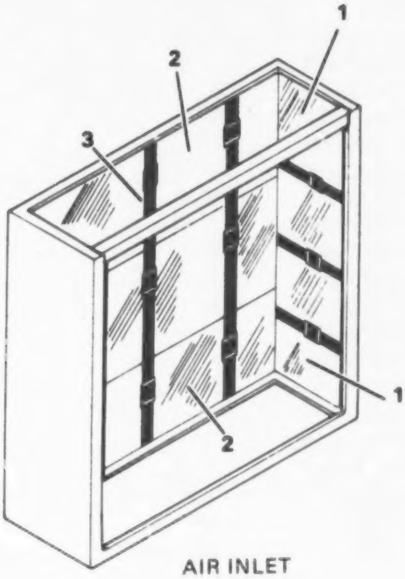
5.14 SOUND CONTROL

key no.	*description*	*part no.*	*qty.*
1	panel, fiberglass, 16" x 27 1/2"	47823-013	1
2	panel, fiberglass, 16" x 23 1/2"	47823-005	3
3	panel, fiberglass, 16" x 48"	47823-004	3
4	panel, fiberglass, 21 1/2" x 25"	47823-009	4
5	panel, fiberglass, 9 3/8" x 46"	47823-010	1
6	panel, fiberglass, 18" x 29 1/2"	47823-014	10
7	panel, fiberglass, 21" x 25"	47823-001	2
8	panel, fiberglass, 28 3/4" x 8"	47823-003	4
9	panel, fiberglass, 18 1/2" x 48"	47823-007	4
10	panel, fiberglass, 18 1/2" x 20"	47823-008	2
11	panel, fiberglass, 16" x 36 1/2"	47823-016	1
12	panel, fiberglass, 16" x 8 1/2"	47823-006	1
13	panel, fiberglass, 16" x 25"	47823-002	3
14	panel, fiberglass, 14 1/2" x 14 1/2"	47823-020	1
15	panel, fiberglass, 28" x 19 1/2"	47823-019	1
16	panel, fiberglass, 28" x 19 1/2"	47823-012	1
17	strapping, steel, 1/2", cut to length	47829	700 (feet)
18	buckle, strapping	47820	187
19	seal, door, sponge rubber, cut to fit	13978*	32 (feet)
20	panel, fiberglass, 24" x 29 1/2" (air exhaust duct sides)	47823-015*	4
21	panel, fiberglass, 15" x 35 1/2" (muffler cover)	47823-017*	4
22	panel, fiberglass, 14" x 35 1/2" (muffler cover)	47823-018*	2
	tubing, steel, cut to fit	841115-006*	5 (feet)

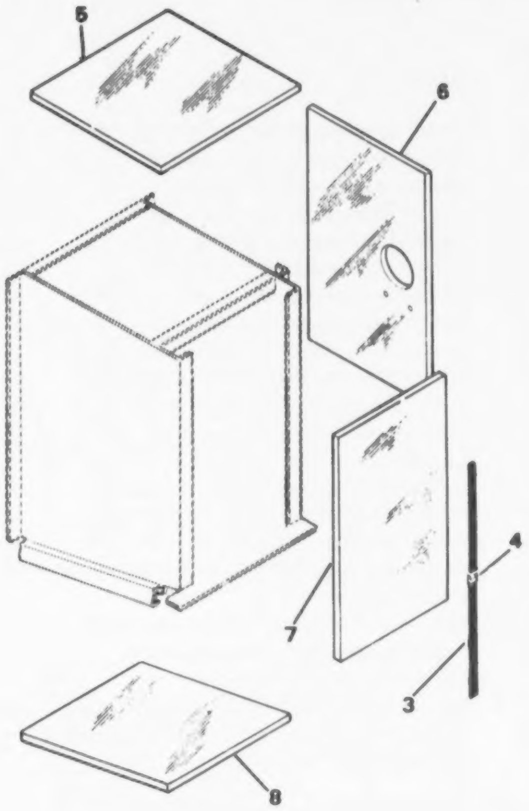
* Item numbers 19 thru 22 not illustrated.

ILLUSTRATIONS AND PARTS LISTS

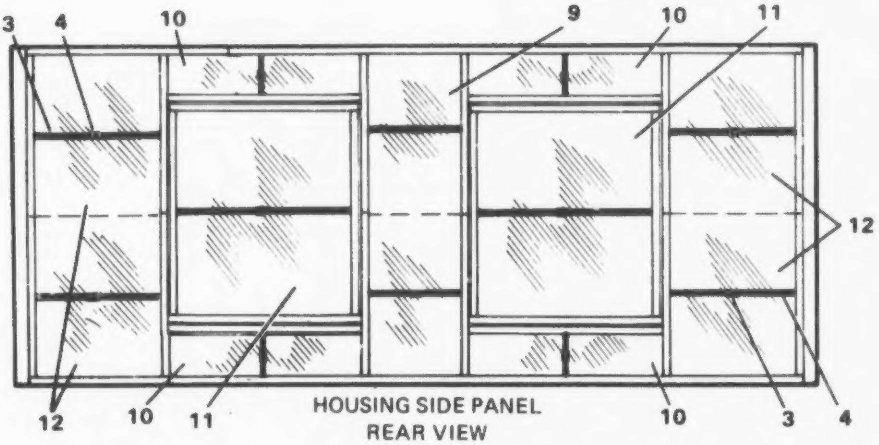
5.15 SOUND CONTROL



AIR INLET DUCT



AIR DISCHARGE.
HOUSING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HOUSING SIDE PANEL
REAR VIEW
STREET SIDE

5.15 SOUND CONTROL

key no.	*description*	*part no.*	*qty.*
1	panel, fiberglass, 59" x 15 3/4"	47823-046	4
2	panel, fiberglass, 40" x 19 1/2"	47823-045	6
3	strapping, steel, 1/2", cut to length	47829	700 (feet)
4	buckle, strapping	47820	29
5	panel, fiberglass, 16 1/2" x 17 1/2"	47823-043	1
6	panel, fiberglass, 15 1/2" x 26"	47823 044	1
7	panel, fiberglass, 17" x 26"	47823-041	1
8	panel, fiberglass, 13 1/2" x 17"	47823-040	1
9	panel, fiberglass, 16" x 25"	47823-002	2
10	panel, fiberglass, 28 3/4" x 8"	47823-003	4
11	panel, fiberglass, 28" x 19 1/2"	47823-012	2
12	panel, fiberglass, 21" x 25"	47823-001	4

WHEN ORDERING PARTS, ALWAYS INDICATE SERIAL NUMBER OF MACHINE

SULLAIR MINING & CONSTRUCTION DISTRIBUTORS 6/28/78

ALABAMA

Young & Vann Supply Co.		
	Birmingham	205 252-5161
	Decatur	205 353-5621
	Dothan	205 794-8641

ALASKA

Howard-Cooper Corp.		
	Fairbanks	907 452-2181
	Anchorage	907 279-5411

ARIZONA

Sullair of Arizona, Inc.		
	Scottsdale	602 949-7140
Road Machinery Co.		
	Phoenix	602 252-7121
	Tucson	602 628-8681

ARKANSAS

Choctaw Machinery, Inc.		
	Little Rock	501 376-3581

CALIFORNIA

Sullair of So. Calif., Inc.		
	Long Beach	213 595-4407
Sullair Pacific, Inc.		
	San Leandro	415 895-8333
B.S. & E. Equipment Co., Inc.		
	Bakersfield	805 327-2288
Contractors Equipment Co.		
	San Diego	714 298-9847
Sequoia Machinery Co.		
	Fresno	209 485-6111

COLORADO

Sullair Rocky Mtn., Inc.		
	Denver	303 232-8333
B.H. Machinery Co.		
	Grand Junction	303 243-1211
Construction Rental & Sales		
	Ft. Collins	303 482-9523
Fleet Equipment Co.		
	Commerce City	303 287-2571
Lakewood Equipment Co.		
	Lakewood	303 233-5520
Wylaco Supply Co.		
	Denver	303 778-8201

CONNECTICUT

Rowen-Leahy Co.		
	Newington	203 667-2221

FLORIDA

Sullair of Florida, Inc.		
	Orlando	305 857-2947
Sullair Latinoamerica Corp.		
	Miami	305 572-7579
Compressed Air Products		
	Mulberry	813 425-1133
M.D. Moody & Sons		
	Jacksonville	904 737-4401
	Ft. Lauderdale	305 587-4300
	Tampa	813 626-3181

GEORGIA

Sullair Southeast, Inc.		
	Atlanta	404 455-6605
R.S. Armstrong & Bros. Co.		
	Atlanta	401 524-6434
	Savannah	912 232-8148

HAWAII

Inter-Island Equipment Co.		
	Agana, Guam	808 746-4479
	Hilo	808 961-3491
	Kahului	808 887-6537
	Waipahu	808 671-3911

IDAHO

Foulger Equipment Co.		
	Boise	208 343-3603
	Pocatello	208 233-5647

ILLINOIS

Sullair of Chicago, Inc.		
	Downers Grove	312 969-2505
Central Illinois Road Machinery Co.		
	Springfield	217 544-1731
Hennessey-Forrestal Machinery Co.		
	Springfield	217 544-3900
Illinois Contractors Machinery, Inc.		
	Peoria	309 691-4255
	Milan	309 787-1714
	Springfield	217 544-5478
Machinery, Inc.		
	Peoria	309 674-1174
	Springfield	217 528-7303
McAllister Equipment Co.		
	Alsip	312 568-1700
	Des Plaines	312 298-7454
Metro Construction Equipment Co.		
	Cahokia	618 337-4233
Rockford Power		
	Rockford	815 962-8848
S & K Rigging		
	Arcola	217 268-3434

INDIANA

Sullair of Indiana, Inc.		
	Indianapolis	317 357-8721
Sullair Midwest, Inc		
	Burns Harbor	219 762-6531
Mallotte Machinery, Inc.		
	Petersburg	812 354-8818
Rudd Equipment Corp.		
	Indianapolis	317 247-9125
Stockberger Machinery Co.		
	Evansville	812 479-9161
	Ft. Wayne	219 483-8141
	Indianapolis	317 248-9431
	South Bend	219 282-1287

IOWA

All Wheel Drive Co.		
	Cedar Falls	319 266-7569
	Davenport	319 326-6283
	Des Moines	515 265-8581
	Ft. Dodge (Hm Off)	515 572-7126
	Ft. Dodge	515 972-4426
	Sioux City	712 255-9800

KANSAS

Conmaco, Inc.		
	Kansas City	913 371-3930
Continental Equipment, Ltd.		
	Salina	913 825-8141
Distributor to Industry		
	Wichita	316 522 4711
Halco, Inc.		
	Kansas City	913 281-5700
Int'l Petroleum Services		
	El Dorado	316 321-2770
Midcon Equipment Co.		
	Topeka	913 267-3300
Murphy Machinery Co.		
	Wichita	316 942-8331
Sisco, Inc.		
	Wichita	316 943-4237

KENTUCKY

Rudd Construction Equipment Co.		
	Ashland	606 325-8415
	Corbin	606 528-9440
	Louisville	502 456-4050

LOUISIANA

Sullair of Louisiana, Inc.	Morgan City	504 384-6393
Sullair of New Orleans, Inc.	Harvey	504 366-1364
General Equipment, Inc.	Baton Rouge	504 293-3683

MARYLAND

Sullair Mid-Atlantic, Inc.	Baltimore	301 685-4404
General Supply & Equipment Co.	Baltimore	301 235-6300
	Salisbury	301 742-8990
Rish Equipment Co.	Frostburg	301 689-2211

MASSACHUSETTS

Sullair of New England, Inc.	Woburn	617 935-6910
State Equipment Co. Division of SECORP NAT'L INC.	Burlington	617 272-5300

MICHIGAN

Sullair of Michigan, Inc.	Grand Rapids	616 452-1481
Sullair of Detroit, Inc.	Detroit	313 564-6767
Thompson Equipment Co.	Iron Mountain	906 774-6543
Burridge, Inc.	Negaunee	906 475-4117
R.B. Richardson Co.	Royal Oak	313 399-5400
Tri-Cities Equipment Co.	Freeland	517 695-9664
Snyder Equipment Co.	Troy	313 361-2200
Universal Equipment Co	Troy	313 585-8484

MINNESOTA

Sullair North Central, Inc.	Minneapolis	612 881-2900
Barry & Sewall Industrial Supply	Minneapolis	612 331-6170
Granite City Tool Co.	St. Cloud	612 251-8600
Lakeshore, Inc.	Hibbing	218 263-7571

MISSISSIPPI

Choctaw Machinery, Inc.	Jackson	601 353-3573

MISSOURI

Sullair of St Louis, Inc.	Maryland Heights	314 569-1530
Sullair Sales & Service	Kansas City	816 241-1813
Sullair of Missouri, Inc.	Lake St. Louis	314 272-7757
Bublitz Machinery Co.	Kansas City	816 221-7335
Hennessey-Forestal Machinery Co.	Fenton	314 343-7500
Int'l Harvester	Liberty	816 781-2727
Machinery, Inc.	St Louis	314 535-2056

MONTANA

Allied Equipment Co.	Billings	406 252-2158
S.J. Perry Co.	Butte	406 792-9148

NEBRASKA

Nebraska Tractor & Equipment Co.	Grant Island	308 384-2620
	Omaha	402 331-9200

NEVADA

Zimmco Equipment Co.	Las Vegas	702 873-4944
	Sparks	702 331-0699

NEW JERSEY

Sullair of New Jersey, Inc.	Cedar Grove	201 857-1155
Furnival Machinery Co.	Carlstadt	201 933-8282
Holt Machinery Co.	Cranford	201 272-6622

NEW MEXICO

Border Machinery Co.	Albuquerque	505 242-2831
	El Paso	915 533-7564
	Farmington	505 327-3356

NEW HAMPSHIRE

C.R. Wood Corp.	Manchester	603 625-5449
	Portland	207 797-4100

NEW YORK

Sullair of Syracuse, Inc.	E. Syracuse	315 437-1437
Contractors Supply Co.	Brentwood L.I.	516 231-6200
	L.I.C.	212 721-6800
	Roslyn Heights	516 484-4700
J.W. Francisco Co.	Ravena	518 756-2116
State Equipment Co. Division of SECORP NAT'L INC.	Albany	518 869-5393
	E. Syracuse	315 437-1123
Furnival Machinery Co. of New Jersey	Poughkeepsie	914 452-8820
Rupp Rentals Corp.	Buffalo	716 877-1992

NORTH CAROLINA

Air, Inc.	Charlotte	704 333-0331
North Carolina Equipment Co.	Cary	919 467-0141
	Charlotte	704 392-4151
	Fayettesville	919 425-9151
	Greensboro	919 299-2121
	Kernersville	919 966-3872
	Raleigh	919 833-4811
	Wilmington	919 371-6556 799-3435
	Greenville	919 756-3171

NORTH DAKOTA

Northwestern Equipment Co.	Fargo	701 235-7583
	Minot	701 839-2111

OHIO

Sullair of Northern Ohio, Inc.	Cleveland	216 447-0600
Industrial Tractor Co.	Independence	216 524-9530
	Youngstown	216 758-4554
K & T Equipment Co.	Findley	419 422-4549
Logan Corporation	Cheshire	614 367-7326

OHIO - continued

Rish Equipment Co.	
Cadiz	614 942-4667
Cincinnati	513 771-9230
Cleveland	216 749-4200
Columbus	614 267-5431
Toledo	419 336-3744
Youngstown	216 758-6402
T.C. Johnson Co.	
Chagrin Falls	216 247-7393

OKLAHOMA

Advance Tools & Equipment Co.	
Oklahoma City	405 685-5537
Auxier Scott Supply Co.	
Oklahoma City	405 946-2657
Builders Service Co.	
Tulsa	918 836-6595
Machinery, Inc.	
Tulsa	918 622-1477
Murphy Machinery Co.	
Tulsa	405 685-1134

OREGON

Howard-Cooper Corporation	
Eugene	503 688-7221
Medford	503 779-1073
Portland	503 252-2441

PENNSYLVANIA

Sullair of Pittsburgh, Inc.	
Pittsburgh	412 343-1922
Sullair of Philadelphia, Inc.	
Edgemont	215 353-5191
Lincoln Equipment Co.	
Washington	412 222-2700
Progressive Equipment Co.	
Erie	814 452-4363
State Equipment Co. Division of SECORP NAT'L INC.	
Erie	814 864-4861
Franklin	814 432-2115
Harrisburg	717 652-3190
Lancaster	717 397-7551
Monroeville	412 351-4040
Montgomeryville	215 643-2230
Phillipsburg	814 342-4880
Wilkes-Barre	717 824-9891

SOUTH CAROLINA

R.S. Armstrong Co.	
Columbia	803 786-5250

SOUTH DAKOTA

Kearns Machinery Co.	
Aberdeen	605 225-6240
Rapid City	605 342-4850
Sioux Falls	605 336-3010

TENNESSEE

Sullair of Memphis, Inc.	
Memphis	901 345-2903
Power Equipment Co.	
Chattanooga	615 894-1870
Kingsport	615 349-6111
Knoxville	615 577-5563
Nashville	615 244-1680
Choctaw Machinery, Inc.	
Memphis	901 458-4481

TEXAS

Sullair of Houston, Inc.	
Houston	713 941-2800
Sullair of Dallas, Inc.	
Dallas	214 341-1810
Sullair Venezolana C.A.	
Houston	713 440-4364
Clemtex, Ltd.	
Houston	713 672-8251

TEXAS - continued

Conley-Lott Nichols	
Amarillo	806 383-3352
Lubbock	806 744-2311
Houston	713 672-6400
Longview	214 758-5547
Odessa	913 337-3596
Dallas	713 672-6400
San Antonio	512 648-3531
E.L. Lester Co.	
Houston	713 733-4341

UTAH

Sullair Rocky Mtn., Inc.	
Salt Lake City	801 972-6880
Air & Equipment Co.	
Modvale	801 566-2437
Folsom Assoc.	
Salt Lake City	801 972-4600
Foulger Equipment Co.	
Salt Lake City	801 484-7625

VERMONT

State Equipment Co.	
Montpelier	802 229-9177

VIRGINIA

Sullair Mid-Atlantic, Inc	
Charlottesville	804973-1302
General Supply & Equipment Co.	
Merrifield	703 560-2030
Rish Equipment Co.	
Coeburn	703 395-6901
Norfolk	804 461-2600
Richmond	804 321-3100
Salem	703 389-9375
Logan Corporation	
Richlands	703 963-1011

WASHINGTON

Sullair Northwest, Inc.	
Redmond	206 883-9500
Howard-Cooper Corp.	
Seattle	206 762-0510
Spokane	509 534-2687
Modern Machinery Co.	
Spokane	509 535-1654

WEST VIRGINIA

Logan Corporation	
Clarksburg	304 624-7491
Huntington	304 529-3231
Logan	304 752-5200
Nitro	304 755-4313

WISCONSIN

Sullair of Wisconsin	
Glendale	414 351-3611
Lincoln Contractors Supply, Inc.	
Madison	608 249-6476
Milwaukee	414 541-1327
Oshkosh	414 231-3501
Miller-Bradford-Risberg	
Eau Claire	715 832-3443

WYOMING

Rocky Mtn. Machinery	
Capser	307 265-8306
Vrooman Assoc.	
Evansville	307 234-1812
Wyomac	
Casper	307 234-8527

PUERTO RICO

Kane Caribbean, Inc.	
San Juan	809 787-3030

CANADA

Sullair Compressors, Ltd.	
Downsview, Ontario	416 630-8754
Atlantic Compressed Air, Ltd.	
Moncton, New Brunswick	506 384-4441
Halifax South, Nova Scotia	902-423-3236
Canadore Supply, Ltd.	
Sudbury, Ontario	705 560-2500
Comairco Equipment Ltd.	
Downsview, Ontario	416 636-0512
London, Ontario	519 686-1311
Ottawa, Ontario	613 733-3419
Cypress Equipment Co., Ltd.	
North Burnaby, B.C.	604 299-2611
Mumford-Medland,Ltd.	
Calgary, Alberta	403 252-2201
Winnipeg, Manitoba	204 885-4440
Regina, Saskatchewan	306 523-2631
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Volume 2
Engine Operators Manual

Detroit Diesel

V-71 Engines

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DESCRIPTION

PRINCIPLES OF OPERATION

The diesel engine is an internal combustion power unit, in which the heat of fuel is converted into work in the cylinder of the engine.

In the diesel engine, air alone is compressed in the cylinder; then, after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition is accomplished by the heat of compression.

The Two-Cycle Principle

In the two-cycle engine, intake and exhaust take place during part of the compression and power strokes respectively, as shown in Fig. 1. In contrast, a four-cycle engine requires four piston strokes to complete an operating cycle; thus, during one half of its operation, the four-cycle engine functions merely as an air pump.

A blower is provided to force air into the cylinders for expelling the exhaust gases and to supply the cylinders with fresh air for combustion. The cylinder wall contains a row of ports which are above the piston when it is at the bottom of its stroke. These ports admit the air from the blower into the cylinder as soon as the rim of the piston uncovers the ports as shown in Fig. 1 (scavenging).

The unidirectional flow of air toward the exhaust valves produces a scavenging effect, leaving the cylinders full of clean air when the piston again covers the inlet ports.

As the piston continues on the upward stroke, the exhaust valves close and the charge of fresh air is subjected to compression as shown in Fig. 1 (compression).

Shortly before the piston reaches its highest position, the required amount of fuel is sprayed into the combustion chamber by the unit fuel injector as shown in Fig. 1 (power). The intense heat generated during the high compression of the air ignites the fine fuel spray immediately. The combustion continues until the injected fuel has been burned.

The resulting pressure forces the piston downward on its power stroke. The exhaust valves are again opened when the piston is about halfway down, allowing the burned gases to escape into the exhaust manifold as shown in Fig. 1 (exhaust). Shortly thereafter, the downward moving piston uncovers the inlet ports and the cylinder is again swept with clean scavenging air. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft, or, in other words, in two strokes; hence, it is a "two-stroke cycle".

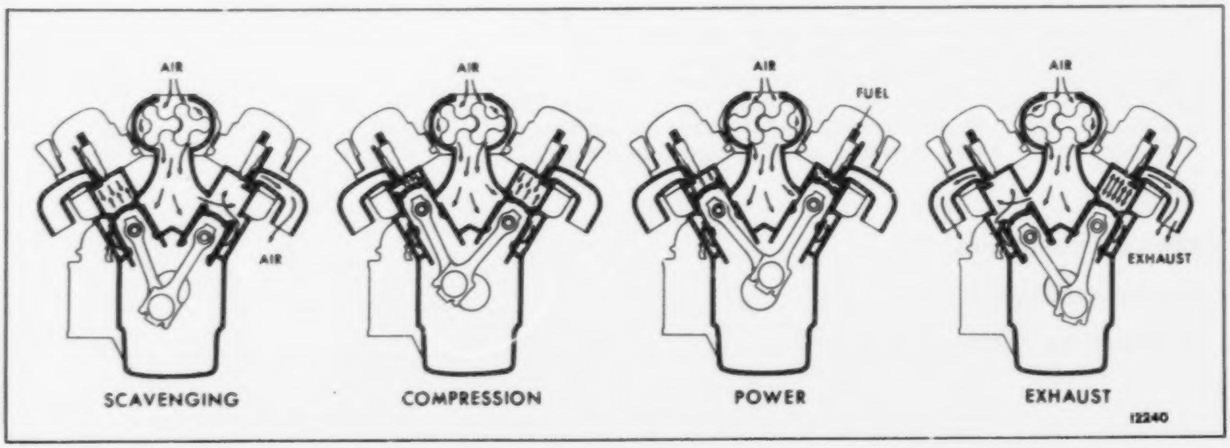


Fig. 1 - The Two-Stroke Cycle

GENERAL DESCRIPTION

The V-71 engines (6, 8, 12 and 16 cylinder models) covered by this manual have the same bore and stroke and use many of the same parts.

All cylinder blocks are symmetrical in design thus permitting oil cooler or starter installation on the same side or on opposite sides of the engine, depending upon the installation requirements. The engines are built with right-hand or left-hand crankshaft rotation. For example, the crankshaft in an RC engine, viewed from the flywheel end, will rotate counterclockwise, the oil cooler will be mounted on the right-hand side of the engine and the starter will be on the left-hand side of the engine (Fig. 2).

There are eight basic engine models. The letter L or R indicates left or right-hand engine rotation as viewed from the front of the engine. The letter A, B, C or D designates the location of the starter and oil cooler as viewed from the rear (flywheel) end. For the meaning of each digit in the model numbering system, refer to Fig. 2.

The engines are normally equipped with an oil cooler, lubricating oil filter(s), fuel oil strainer, fuel oil filter, air cleaner(s) or silencer(s), governor, heat exchanger and raw water pump or fan and radiator, and a starter.

Fuel is drawn from the supply tank and through a strainer by a gear-type fuel pump, then it is forced through the filter and the fuel inlet manifolds in the cylinder heads to the injectors. Excess fuel is returned to the supply tank via the return fuel manifolds and connecting lines. Since fuel is constantly circulating through the injectors, it serves to cool the injectors and carry off any air in the fuel system.

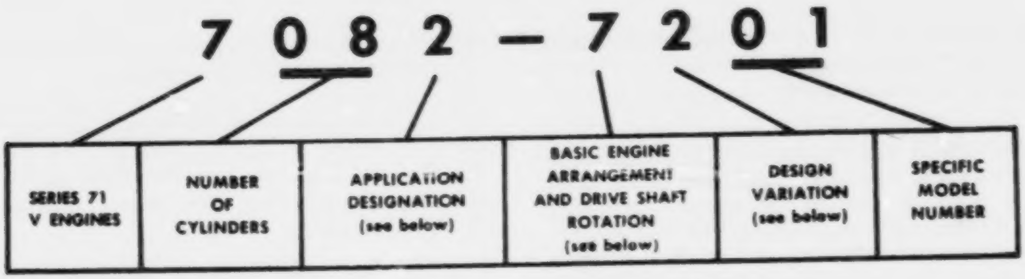
Air for scavenging and combustion is supplied by a blower(s) which pumps air into the engine cylinders via the air box and cylinder liner ports. All air entering the blower(s) first passes through an air cleaner or silencer.

Full pressure lubrication is supplied to all main, connecting rod and camshaft bearings, and to other moving parts of the engine. A gear-type pump draws oil from the oil pan through an intake screen and delivers it to the oil filter(s) and then to the oil cooler(s). From the oil cooler(s) the oil flows through passages that connect with the oil galleries in the cylinder block and cylinder heads for distribution to the bearings, rocker arm mechanism and other functional parts.

Coolant is circulated through the engine by a centrifugal type water pump. Heat is removed from the coolant, which circulates in a closed system, by either a radiator or heat exchanger. Control of the engine temperature is accomplished by thermostats that regulate the flow of the coolant within the cooling system.

Engine starting is provided by either a hydraulic or an electrical starting system.

Engine speed is controlled by a governor. Some engines have a mechanical limiting speed governor, some a mechanical variable speed governor, and other engines use a limiting speed or a variable speed hydraulic governor. The engine application determines which type of governor is used.


7 0 8 2 — 7 2 0 1
SERIES 71 V ENGINES
NUMBER OF CYLINDERS
APPLICATION DESIGNATION (see below)
BASIC ENGINE ARRANGEMENT AND DRIVE SHAFT ROTATION (see below)
DESIGN VARIATION (see below)
SPECIFIC MODEL NUMBER

APPLICATION DESIGNATION.

7082-7200	MARINE
7083-7200	INDUSTRIAL F-F
7084-7200	POWER-BASE
7085-7200	GENERATOR
7087-7200	VEHICLE F-F
7088-7200	SPECIAL

BASIC ENGINE ARRANGEMENTS:

Rotation: L (left) and R (right) designates rotation viewed from the front of the engine.

Type: A-B-C-D designates location of starter and oil cooler as viewed from the rear (flywheel) end.

Cylinder Bank: Left and right cylinder banks are determined from rear of engine.

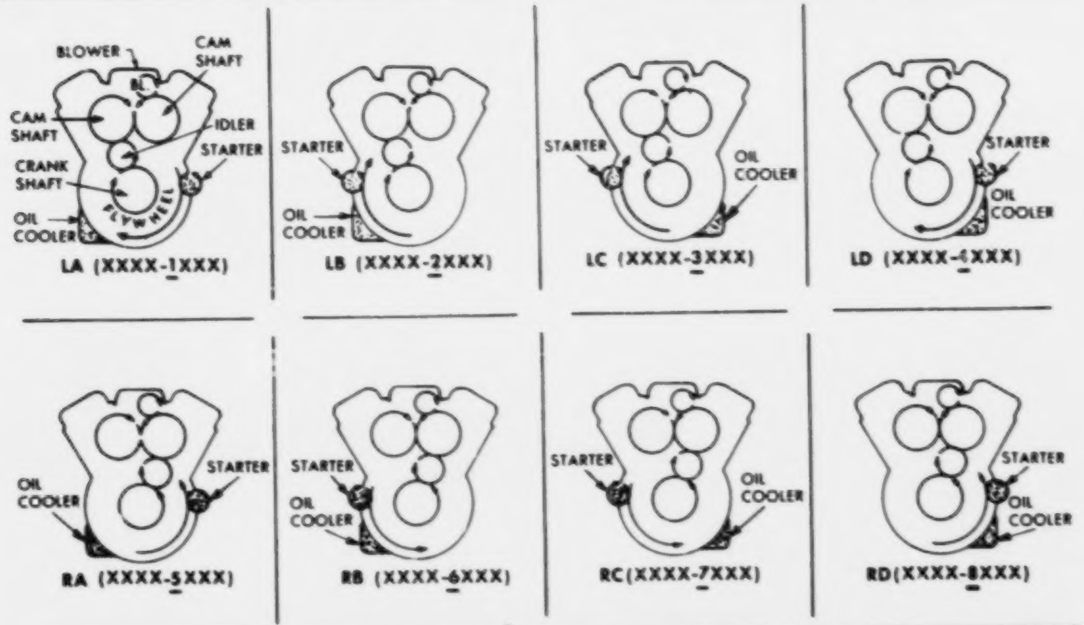
DESIGN VARIATION:

7082-7000	V-71 "N" ENGINE
7082-7100	2 VALVE HEAD ENGINE
7082-7200	4 VALVE HEAD ENGINE
7082-7300	TURBOCHARGED ENGINE
7082-7400	AFTERCOOLED ENGINE
7082-7500	CUSTOMER SPEC. ENGINE

DRIVE SHAFT ROTATION:

7242-0200	LEFT-HAND
7242-9200	RIGHT-HAND

Drive shaft rotation: shaft rotation on multiple units is determined from the rear of the unit.


BLOWER
CAM SHAFT
CAM SHAFT
IDLER
STARTER
CRANK SHAFT
FLYWHEEL
OIL COOLER
LA (XXXX-1XXX)
STARTER
OIL COOLER
LB (XXXX-2XXX)
STARTER
OIL COOLER
LC (XXXX-3XXX)
STARTER
OIL COOLER
LD (XXXX-4XXX)
OIL COOLER
STARTER
RA (XXXX-5XXX)
STARTER
OIL COOLER
RB (XXXX-6XXX)
STARTER
OIL COOLER
RC(XXXX-7XXX)
STARTER
OIL COOLER
RD(XXXX-8XXX)

ALL ABOVE VIEWS FROM REAR OF ENGINE

11473

Fig. 2 - Model Description, Rotation, and Accessory Arrangement

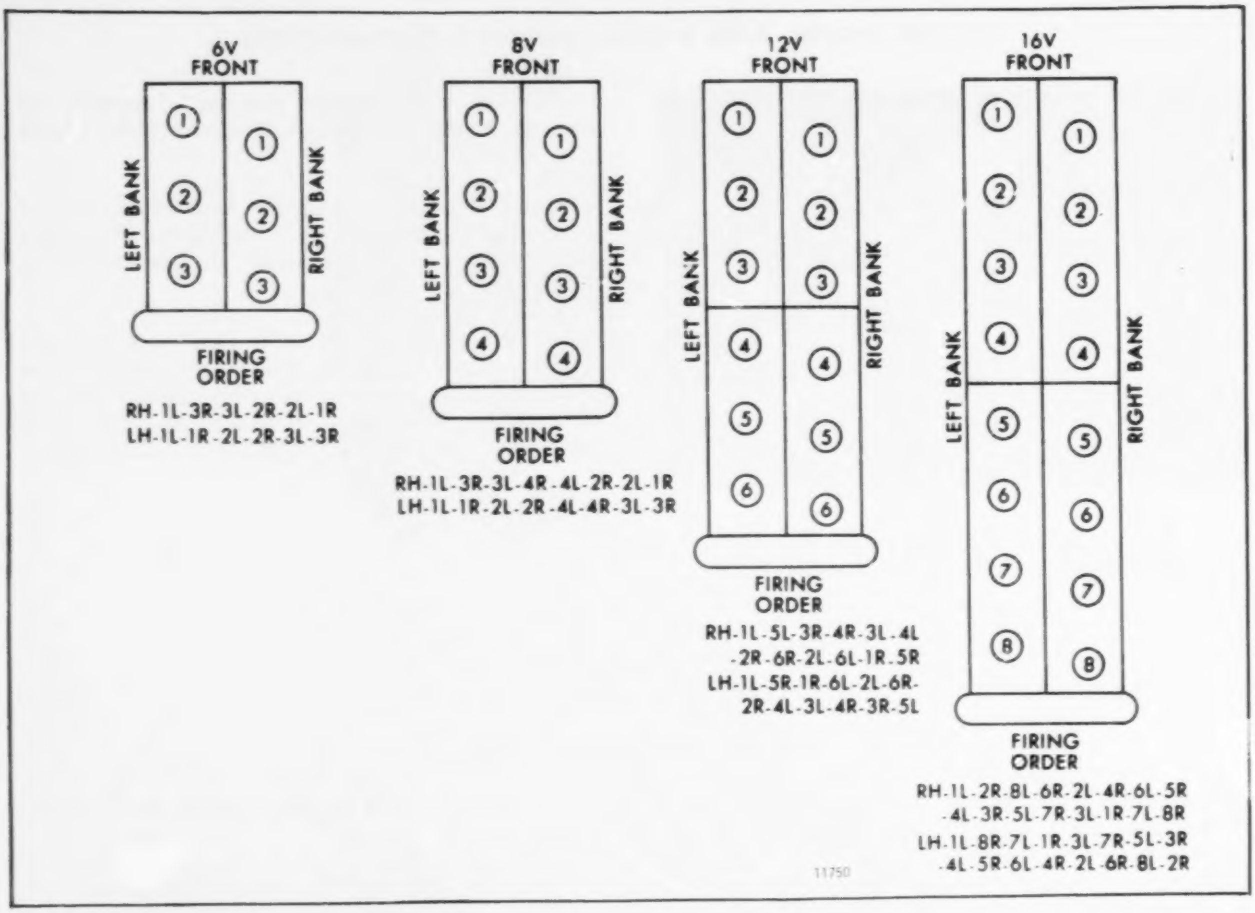

6V
FRONT
LEFT BANK
RIGHT BANK
1
2
3
1
2
3
FIRING ORDER
RH-1L-3R-3L-2R-2L-1R
LH-1L-1R-2L-2R-3L-3R
8V
FRONT
LEFT BANK
RIGHT BANK
1
2
3
4
1
2
3
4
FIRING ORDER
RH-1L-3R-3L-4R-4L-2R-2L-1R
LH-1L-1R-2L-2R-4L-4R-3L-3R
12V
FRONT
LEFT BANK
RIGHT BANK
1
2
3
4
5
6
1
2
3
4
5
6
FIRING ORDER
RH-1L-5L-3R-4R-3L-4L-2R-6R-2L-6L-1R-5R
LH-1L-5R-1R-6L-2L-6R-2R-4L-3L-4R-3R-5L
16V
FRONT
LEFT BANK
RIGHT BANK
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
8
FIRING ORDER
RH-1L-2R-8L-6R-2L-4R-6L-5R-4L-3R-5L-7R-3L-1R-7L-8R
LH-1L-8R-7L-1R-3L-7R-5L-3R-4L-5R-6L-4R-2L-6R-8L-2R
11750

Fig. 3 - V-71 Cylinder Designation and Firing Order

GENERAL SPECIFICATIONS

	6V	8V	12V	16V
Type	2 Cycle	2 Cycle	2 Cycle	2 Cycle
Number of Cylinders	6	8	12	16
Bore (inches)	4.25	4.25	4.25	4.25
Bore (mm)	108	108	108	108
Stroke (inches)	5	5	5	5
Stroke (mm)	127	127	127	127
Compression Ratio (Nominal)(Standard Engines)	17 to 1	17 to 1	17 to 1	17 to 1
Compression Ratio (Nominal)("N" Engines)	18.7 to 1	18.7 to 1	18.7 to 1	18.7 to 1
Total Displacement - cubic inches	426	568	852	1136
Total Displacement - litres	6.99	9.32	13.97	18.63
Number of Main Bearings	4	5	7	10

ENGINE MODEL AND SERIAL NUMBER DESIGNATION

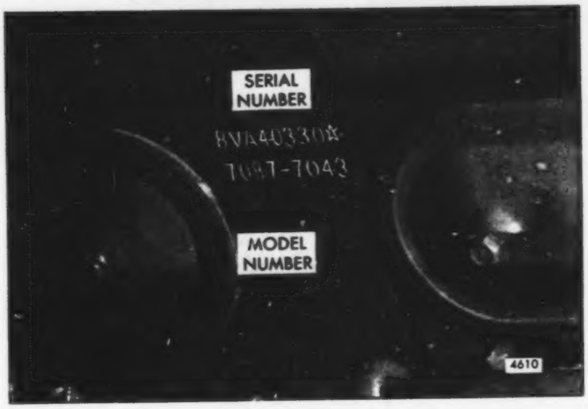


Fig. 4 - Typical Engine Serial Number and Model Number as Stamped on Cylinder Block

The engine serial number and model number are stamped on the right-hand side of the cylinder block (Fig. 4).

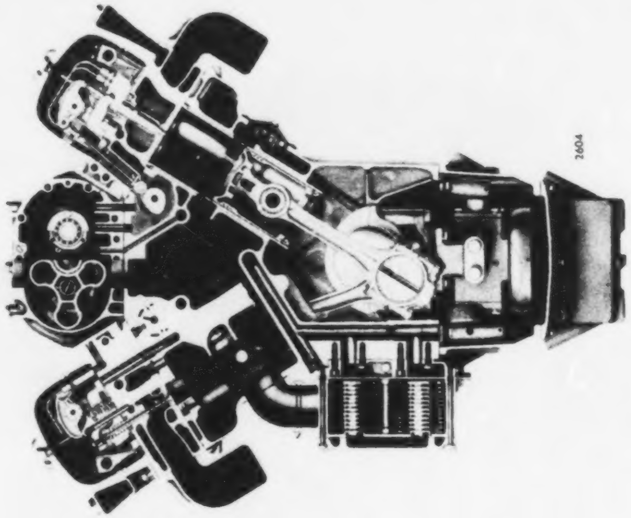
Engines with optional equipment have an option plate attached to one of the valve rocker covers. The engine serial number and model number are also stamped on this plate.

Power take-off assemblies, torque converters, hydraulic marine gears, etc. may also carry name plates pertaining to the particular assembly to which they are attached. The information on these name plates should be included when ordering parts for these assemblies.

BUILT-IN PARTS BOOK

The *Built-In Parts Book* is an anodized aluminum plate (option plate) that fits into a retainer on one of the engine valve rocker covers and contains the necessary information required when ordering parts. It is recommended that the engine user read the section on the *Built-In Parts Book* in order to take full advantage of the information provided on the engine option plate.

Numerous exploded view type illustrations are included to assist the user in identifying and ordering service parts.



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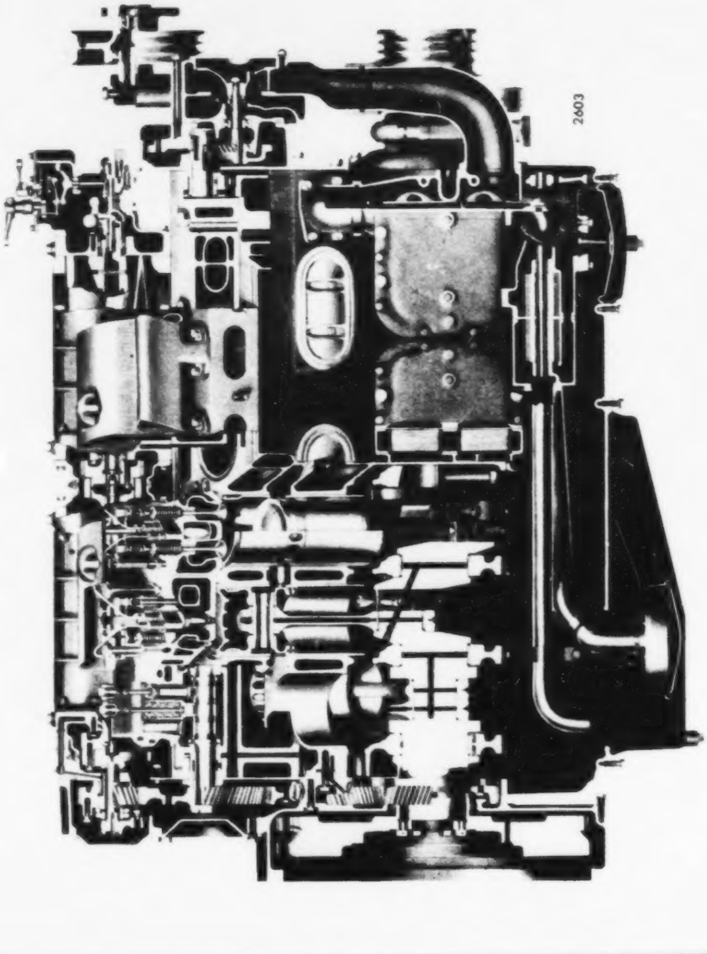

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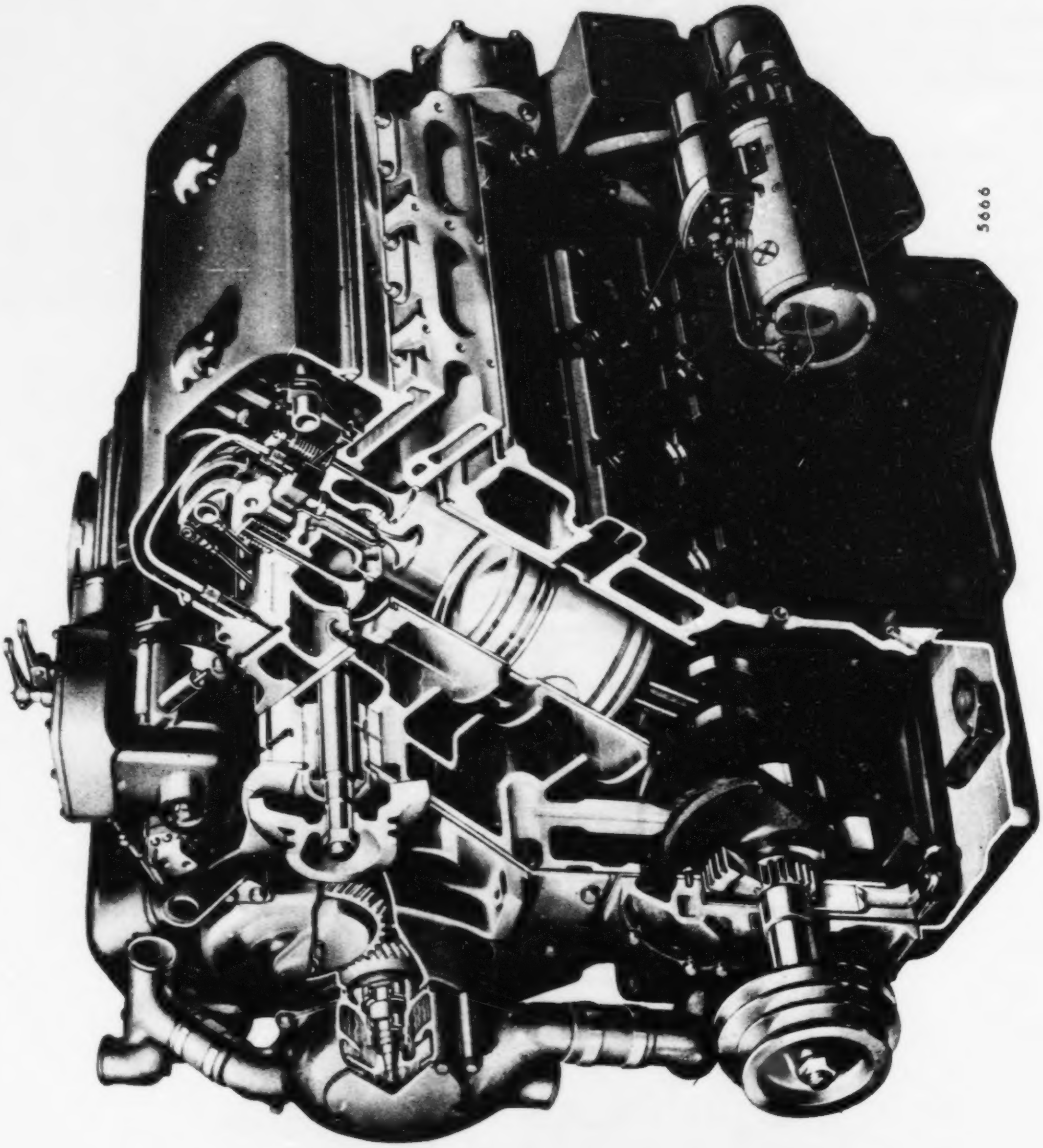
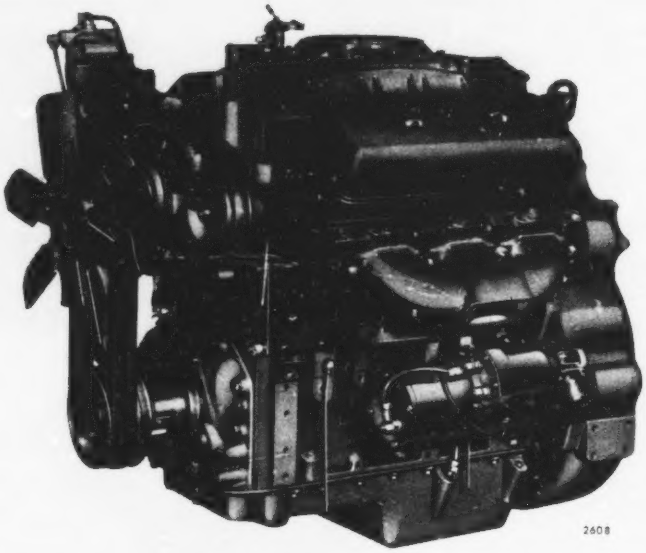
Cross Section Views of a Typical V-71 Engine



Three-Quarter Cutaway View of V-71 Engine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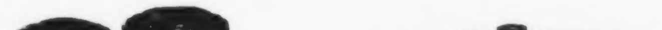
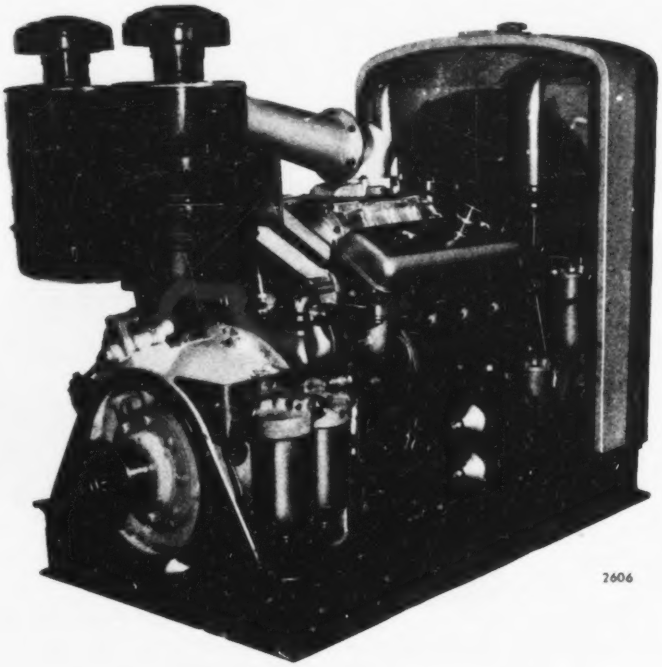
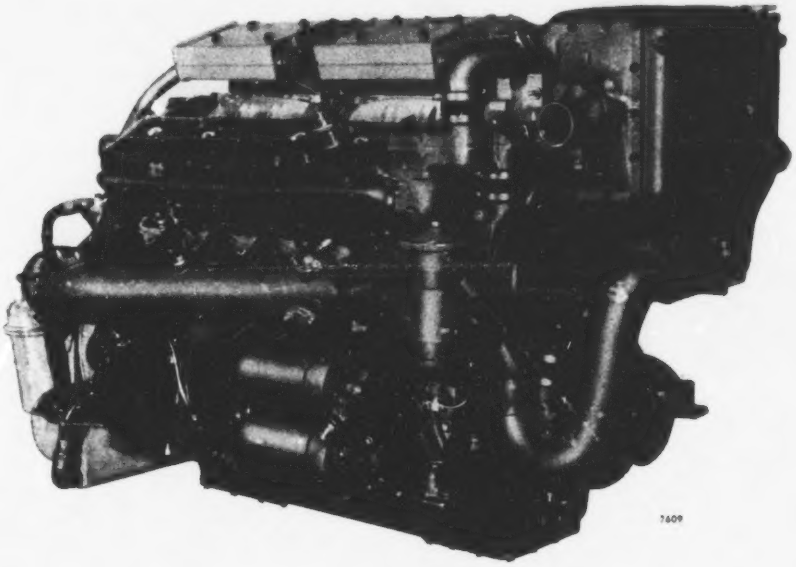
Typical Fan-to-Flywheel Unit (6V)

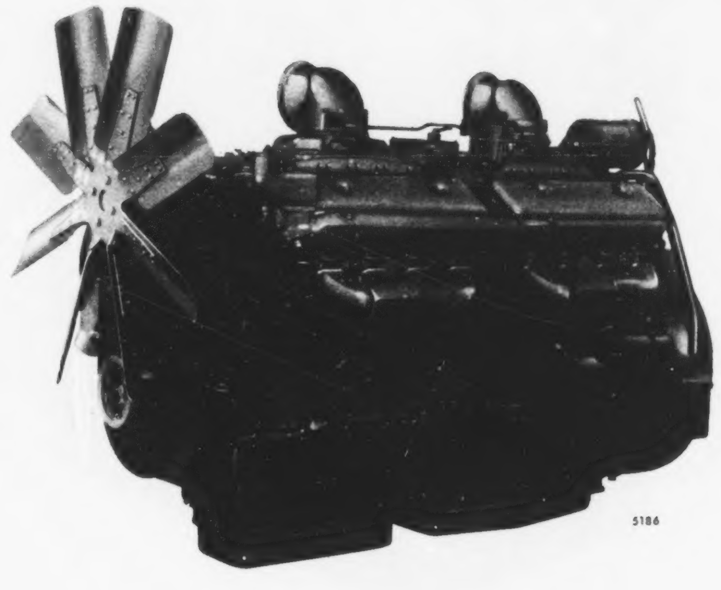



2606

Typical Industrial Torque Converter Unit (8V)



Typical Marine Propulsion Engine (12V)



Typical Fan-to-Flywheel Engine (16V)

ENGINE SYSTEMS

The V-71 Detroit Diesel engines incorporate four basic systems which direct the flow of fuel, air, lubricating oil, and engine coolant.

A brief description of each of these systems and their components, and the necessary maintenance and adjustment procedures, are given in this manual.

FUEL SYSTEM

The fuel system (Fig. 1) consists of the fuel injectors, fuel pipes, fuel pump, fuel strainer, fuel filter and the necessary connecting fuel lines.

A restricted fitting is located in the outlet passage in one of the cylinder heads on 6, 8 and 12V engines to maintain pressure in the fuel system. Two of the cylinder heads on 16V engines have a restricted fitting.

Fuel is drawn from the supply tank through the fuel strainer and enters the fuel pump at the inlet side. Upon leaving the pump under pressure, the fuel is forced through the fuel filter and into the fuel inlet manifold where it passes through fuel pipes into the inlet side of each fuel injector. The fuel is filtered through elements in the injectors and atomized through small spray tip orifices into the combustion chamber. Surplus fuel, returning from the injectors, passes through the fuel return manifold and connecting fuel lines back to the fuel tank.

The continuous flow of fuel through the injectors helps to cool the injectors and remove air from the fuel system.

A check valve may be installed between the fuel strainer and the source of supply as optional equipment to prevent fuel drain back when the engine is not running.

Fuel Injector

The fuel injector combines in a single unit all of the parts necessary to provide complete and independent fuel injection at each cylinder. The injector creates the high pressure necessary for fuel injection, meters the proper amount of fuel, atomizes the fuel, and times the injection into the combustion chamber.

Since the injector is one of the most important and carefully constructed parts of the engine, it is recommended that the engine operator replace the injector as an assembly if it is not operating properly. Authorized *Detroit Diesel Allison Service Outlets* are properly equipped to service injectors.

Remove Injector

An injector may be removed in the following manner:

1. Remove the valve rocker cover.

2. Disconnect the fuel pipes from both the injector and the fuel connectors.

3. Immediately after removing the fuel pipes, cover the injector inlet and outlet fittings with shipping caps to prevent dirt from entering.

4. Turn the crankshaft manually in the direction of engine rotation or crank the engine with the starting motor, if necessary, until the rocker arms for the particular cylinder are aligned in a horizontal plane.

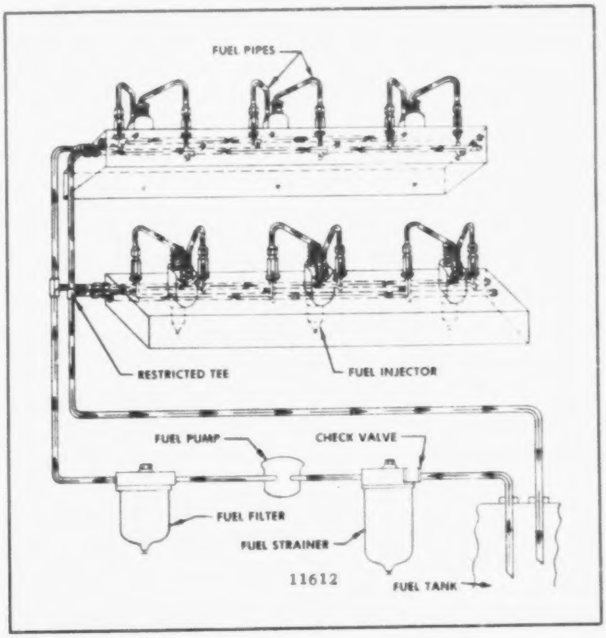


Fig. 1 - Schematic Diagram of Typical Fuel System

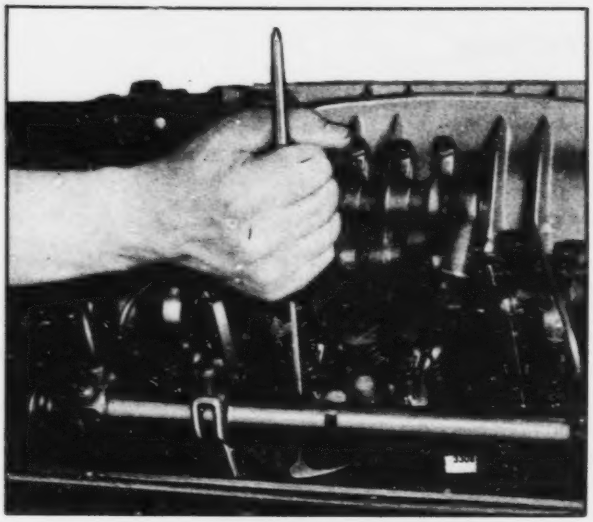


Fig. 2 - Removing Injector from Cylinder Head

> **CAUTION:** If a wrench is used on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation as the bolt may be loosened. Either remove the starting motor or the pipe plug in the flywheel housing and use a pry bar against the teeth of the flywheel ring gear to turn the crankshaft.

5. Remove the two rocker shaft bracket bolts and swing the rocker arm assembly away from the injector and valves.

6. Remove the injector clamp bolt, washer and clamp.

7. Loosen the inner and outer adjusting screws on the injector rack control lever and slide the lever away from the injector.

8. Free the injector from its seat as shown in Fig. 2 and lift it from the cylinder head.

9. Cover the injector hole in the cylinder head to keep foreign particles out of the cylinder.

Install Injector

Before installing an injector, be sure the beveled seat of the injector tube is free from dirt particles and carbon deposits.

A new or reconditioned injector may be installed by reversing the sequence of operations given for removal.

Be sure the fuel injector is filled with fuel oil. If necessary, add clean fuel oil at the inlet filter until it runs out the outlet filter.

Do not tighten the injector clamp bolt to more than 20-25 lb-ft (27-34 Nm) torque, as this may cause the moving parts of the injector to bind. Tighten the rocker shaft bolts to 90-100 lb-ft (122-136 Nm) torque.

Align the fuel pipes and connect them to the injector and the fuel connectors. Use socket J 8932-01 and a torque wrench to tighten the fuel pipe nuts to 12-15 lb-ft (16-20 Nm) torque.

> **CAUTION:** Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

Time the injector, position the injector rack control lever and adjust the exhaust valve clearance (cold setting) as outlined in the engine tune-up procedure. If all of the injectors have been replaced, perform a complete tune-up on the engine.

Fuel Pump

A positive displacement gear type fuel pump is attached to the blower and driven off the front end of the blower.

A spring-loaded relief valve, incorporated in the pump body, normally remains in the closed position, operating only when the pressure on the outlet side (to the fuel filter) becomes excessive due to a plugged filter or fuel line.

The fuel pump incorporates two oil seals. Two tapped holes are provided in the underside of the pump body to permit draining off any leakage of oil.. If fuel leakage exceeds one drop per minute, the seals must be replaced. An authorized *Detroit Diesel Allison Service Outlet* is properly equipped to replace the seals.

The fuel pump used on the V-71 engines is a left-hand rotating pump. Regardless of engine rotation, the pump will always rotate in a left-hand direction.

Fuel Strainer and Fuel Filter

A replaceable element type fuel strainer and fuel filter (Figs. 1 and 3) are used in the fuel system to remove impurities from the fuel. The strainer removes the larger foreign particles and the filter removes the small foreign particles.

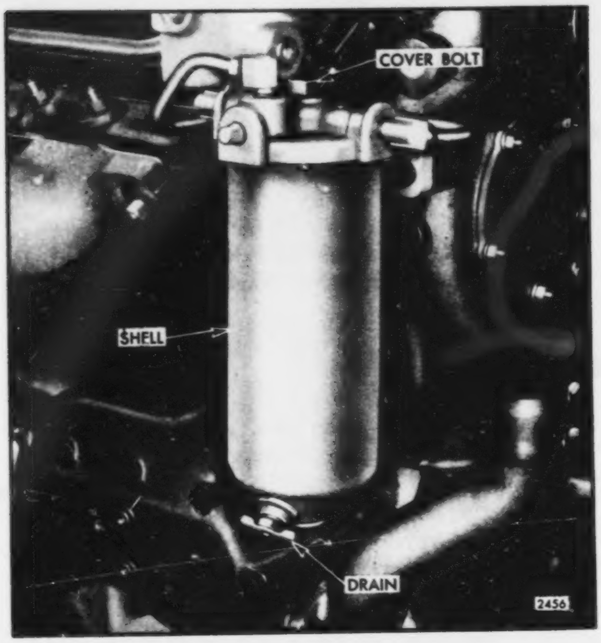


Fig. 3 - Typical Fuel Filter Mounting

The fuel strainer and fuel filter are basically identical in construction, both consisting of a cover, shell and replaceable element. Since the fuel strainer is placed between the fuel supply tank and the fuel pump, it functions under suction; the fuel filter, which is installed between the fuel pump and the fuel inlet manifold in the cylinder head, operates under pressure.

Replace the elements as follows:

1. With the engine shut down, place a suitable container under the fuel strainer or filter and open the drain cock. The fuel will drain more freely if the cover nut is loosened slightly.

2. Support the shell, unscrew the cover nut and remove the shell and element.

3. Remove and discard the element and gasket. Clean the shell with fuel oil and dry it with compressed air.

4. Place a new element, which has been thoroughly soaked in clean fuel oil, over the stud and push it down on the seat. Close the drain cock and fill the shell approximately two-thirds full with clean fuel oil.

5. Affix a new shell gasket, place the shell and element into position under the cover and start the cover nut on the shell stud.

6. Tighten the cover nut only enough to prevent fuel leakage.

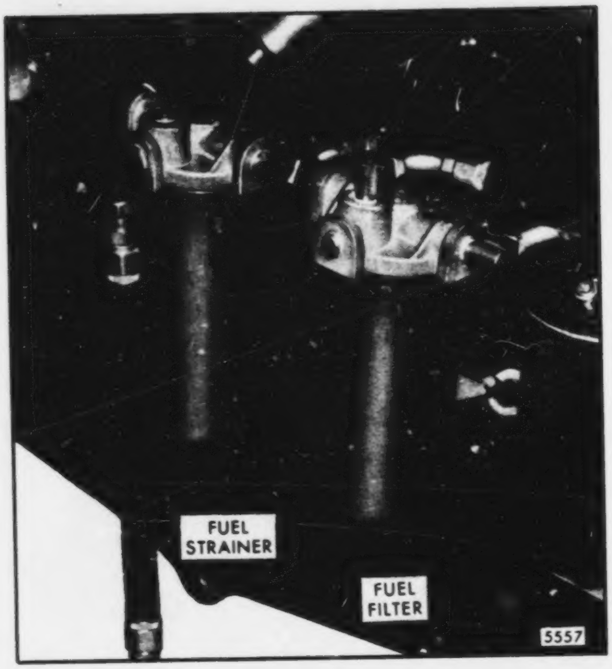


Fig. 4 - Typical Spin-On Fuel Filter Mounting

7. Remove the plug in the strainer or filter cover and fill the shell with fuel. Fuel system primer J 5956 may be used to prime the fuel system.

8. Start and operate the engine and check the fuel system for leaks.

Spin-On Type Fuel Filter

A spin-on type fuel strainer and fuel filter (Fig. 4) is used on certain engines. The spin-on filter cartridge consists of a shell, element and gasket combined into a unitized replacement assembly. No separate springs or seats are required to support the filters.

The filter covers incorporate a threaded sleeve to accept the spin-on filter cartridges. The word "Primary" is cast on the fuel strainer cover and the word "Secondary" is cast on the fuel filter cover for identification.

No drain cocks are provided on the spin-on filters. Where water is a problem, it is recommended that a water separator be installed. Otherwise, residue may be drained by removing and inverting the filter. Refill the filter with clean fuel oil before reinstalling it.

A 1" diameter twelve-point nut on the bottom of the filter is provided to facilitate removal and installation.

Replace the filter as follows:

1. Unscrew the filter (or strainer) and discard it.

2. Fill a new filter replacement cartridge about two-thirds full with clean fuel oil. Coat the seal gasket lightly with clean fuel oil.

3. Install the new filter assembly and tighten it to two-thirds of a turn beyond gasket contact.

4. Start the engine and check for leaks.

Fuel Tank

Refill the fuel tank at the end of each day's operation to prevent condensation from contaminating the fuel.

> **CAUTION:** A galvanized steel tank should never be used for fuel storage because the fuel oil reacts chemically with the zinc coating to form powdery flakes which quickly clog the fuel strainer and filter and damage the fuel pump and injectors.

AIR SYSTEM

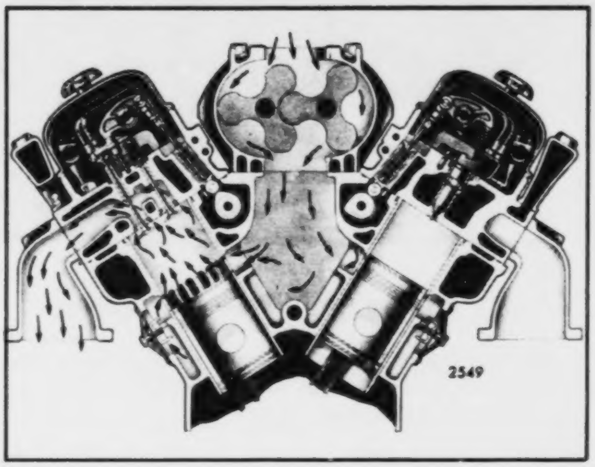


Fig. 5 - Air Intake System Through Blower and Engine

In the scavenging system used in two-cycle engines and illustrated in Fig. 5, a charge of air, forced into the cylinders by the blower(s), sweeps all of the exhaust gases out through the exhaust valve ports, leaving the cylinders filled with fresh air for combustion at the end of each upward stroke of the pistons. This air also helps to cool the internal engine parts, particularly the exhaust valves. At the beginning of the compression stroke, each cylinder is filled with fresh, clean air which provides for efficient combustion.

The blower(s) supplies fresh air required for combustion and scavenging. The hollow three-lobe rotors are closely fitted into the blower housing(s) which is bolted to the cylinder block. The revolving motion of these rotors pulls fresh air through the air cleaner or silencer and provides a continuous and uniform displacement of air in each combustion chamber. The continuous discharge of fresh air from the blower creates a pressure in the air box (air box pressure).

OIL BATH TYPE AIR CLEANERS

Several types of air cleaners are available for use with the V-71 engines. The light duty oil bath air cleaner (Fig. 6) is used with some marine models and a light or heavy-duty oil bath air cleaner (Fig. 7) is available for industrial engines. Some engines are equipped with a heavy-duty dry type air cleaner or a two-stage dry type air cleaner (Fig. 8). The air cleaners are designed for fast, easy disassembly to facilitate efficient servicing. Maximum protection of the engine against dust and other forms of air contamination is possible if the air cleaner is serviced at regular intervals.

The oil bath air cleaner consists of the body and fixed filter assembly which filters the air and condenses the oil from the air stream so that only dry air enters the engine. The condensed oil is returned to the cup where the dirt settles out of the oil and the oil is recirculated.

A removable element assembly incorporated in the heavy-duty oil bath air cleaners removes a major part of the dust from the air stream thereby decreasing the dust load to the fixed element. An inner cup, which can be removed from the outer oil cup, acts as a baffle in directing the oil laden air to the element and also controls the amount of oil in circulation and meters the oil to the element. The oil cup supports the inner cup, and is a reservoir for oil and a settling chamber for dirt.

Service the *light-duty* oil bath air cleaner (Fig. 6) as follows:

1. Loosen the wing bolt and remove the air cleaner assembly from the air inlet housing. The cleaner may then be separated into two sections; the upper section or body assembly contains the filter element and the

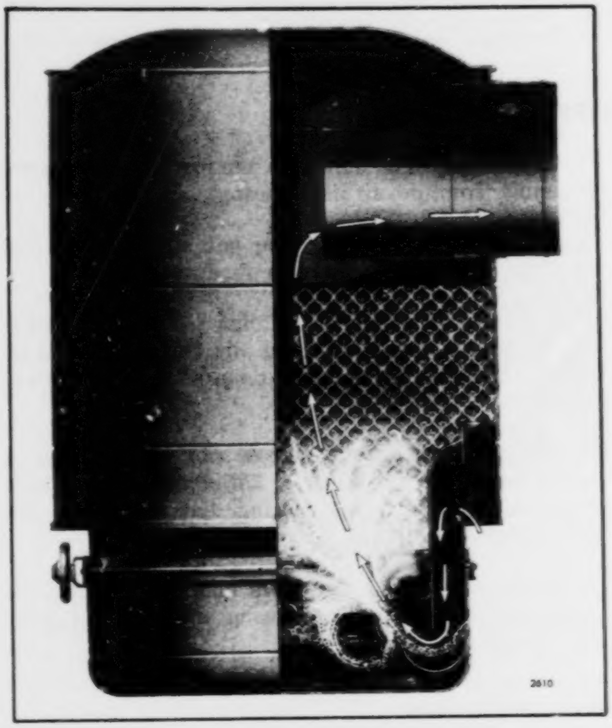


Fig. 6 - Typical Light-Duty Air Cleaner

lower section consists of the oil cup, removable inner cup or baffle, and the center tube.

2. Soak the body assembly and element in fuel oil to loosen the dirt; then flush the element with clean fuel oil and allow it to drain thoroughly.

3. Pour out the oil, separate the inner cup or baffle from the oil cup, remove the sludge and wipe the baffle and outer cup clean.

4. Push a lint-free cloth through the center tube to remove dirt or oil.

5. Clean and check all of the gaskets and sealing surfaces to ensure air tight seals.

6. Refill the oil cup to the oil level mark only, install the baffle and reassemble the air cleaner.

7. Check the air inlet housing before installing the air cleaner assembly on the engine. The inlet will be dirty if air cleaner servicing has been neglected or if dust laden air has been leaking past the air cleaner to the air inlet housing seals.

8. Make sure that the air cleaner is seated properly on the inlet housing and the seal is installed correctly. Tighten the wing bolt until the air cleaner is securely mounted.

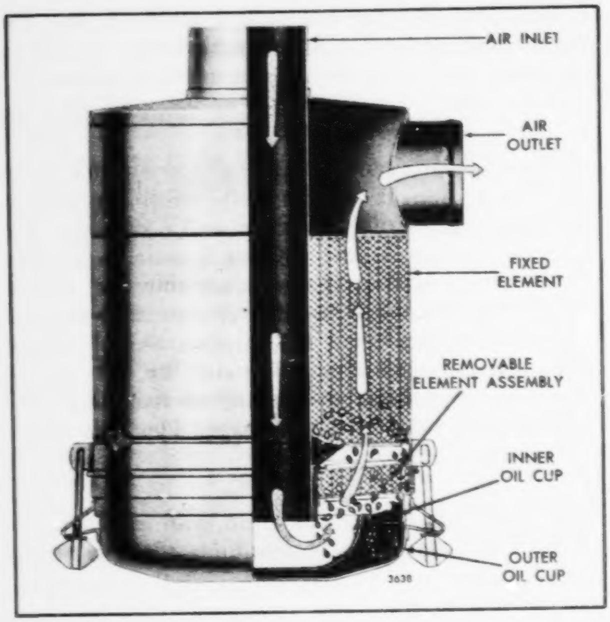


Fig. 7 - Heavy-Duty Oil Bath Air Cleaner

Service the *heavy-duty* oil bath air cleaner (Fig. 7) as follows:

1. Loosen the wing nuts and detach the lower portion of the air cleaner assembly.

2. Lift out the removable element assembly and hold it up to a light. An even, bright pattern of light through the wire element indicates it is clean. Even a partially plugged element must be cleaned with a suitable solvent or fuel oil and blown out with compressed air to remove any dirt, lint or chaff.

3. Pour out the oil, separate the inner cup or baffle from the outer cup, remove the sludge and wipe the baffle and outer cup clean.

4. Clean and inspect the gaskets and sealing surfaces to ensure an air tight seal.

5. Reinstall the baffle in the oil cup and refill to the proper oil level with the same grade of oil as used in the engine.

6. Inspect the lower portion of the air cleaner body and center tube each time the oil cup is serviced. If there are any indications of plugging, the body assembly should be removed and cleaned by soaking and then flushing with clean fuel oil. Allow the unit to drain thoroughly.

7. Place the removable element in the body assembly. Install the body if it was removed from the engine for servicing.

8. Install the outer cup and baffle assembly. Be sure the cup is tightly secured to the assembly body.

HEAVY-DUTY DRY-TYPE AIR CLEANER

The *dry-type* air cleaner consists of a removable cover attached to the air cleaner body which contains a replaceable paper filter cartridge and a dust cup. Air entering the air cleaner is given a centrifugal pre-cleaning by a turbine-type vane assembly. Air rotates at high speed around the filter element throwing the dust to the outside where it flows down the wall of the body and is ejected into a dust cup. The dust cup is baffled to prevent the re-entry of the dust. The pre-cleaned air passes through the paper filter and enters the engine.

Some air cleaners are equipped with an indicator which will aid in determining the servicing requirements.

Service the *dry-type* air cleaner as follows:

1. Loosen the wing bolt and remove the air cleaner assembly from the air inlet housing.

2. Detach the cover and wing bolt and remove the element. Then empty and wipe the dust cup clean.

3. Clean the filter element as follows: If the element is dry and dusty, use compressed air. The air should be blown through the element opposite to the normal direction of air flow.

4. If the element is oily or has soot deposits, use a water hose (less than 40 psi or 276 kPa) and wash with warm water and a non-sudsing detergent. Dry the element thoroughly.

5. Reassemble all of the air cleaner parts, place the assembly on the air inlet housing and secure it with the wing bolts.

TWO-STAGE DRY-TYPE AIR CLEANER

The dry-type air cleaner illustrated in Fig. 8 is designed to provide highly efficient air filtration under all operating conditions and is not affected by engine speed. The cleaner assembly consists of a centrifugal air cleaner in series with a replaceable impregnated paper filter element. The dust collected in the centrifugal cleaner is exhausted by connecting the dust bin to an exhaust gas aspirator. The centrifugal cleaner and replaceable filter element are held together in a steel housing. Positive sealing between the two elements and the housing is provided by rubber gaskets. The steel housing incorporates filter fasteners, mounting flanges and an outlet for the filtered air.

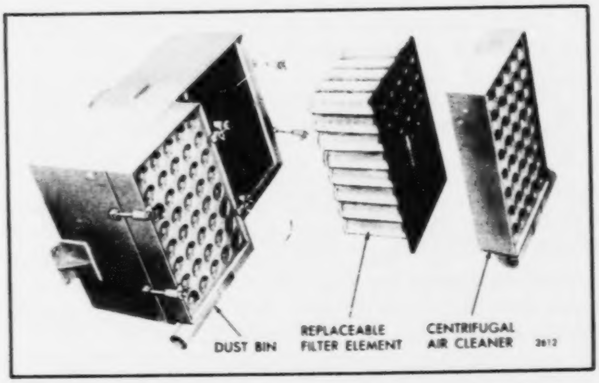


Fig. 8 - Dry Type Air Cleaner

Operation

The deflector vanes (Fig. 9) impart a swirling motion to the air entering the air cleaner and centrifuge the dust particles against the walls of the tubes. The dust particles are then carried to the dust bin at the bottom of the cleaner by approximately 10% bleed-off air and are finally discharged into the atmosphere through an exhaust gas aspirator.

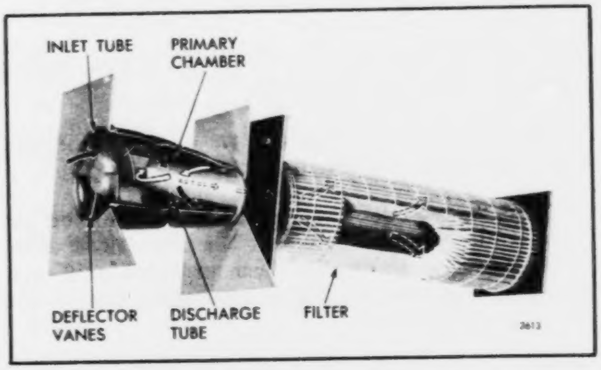


Fig. 9 - Flow of Air Through Filter Element Segment

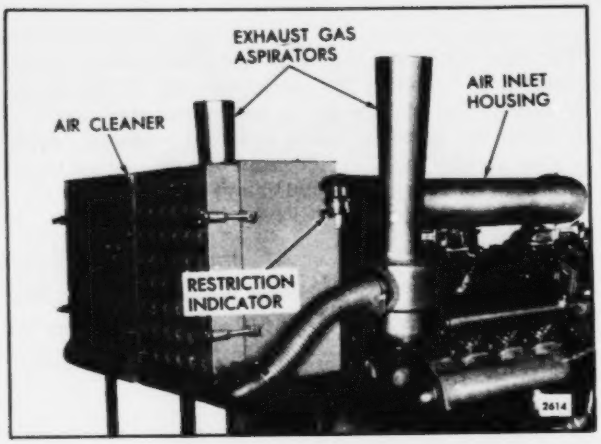


Fig. 10 - Typical Dry Type Air Cleaner Mounting

The exhaust gas aspirator is connected into the exhaust system of the engine (Fig. 10). A flexible hose carries the dust particles from the cleaner dust bin to the aspirator where the waste energy of the exhaust gases draws the dust-laden bleed-off air out and discharges it into the atmosphere along with the engine exhaust gases. Approximately 90% of the total dust load is disposed of in this manner. The centrifugal air cleaner is fully effective at either high or low velocities.

The remainder of the air in the cleaner reverses direction and spirals back along the discharge tubes again centrifugally moving the air. The filtered air then reverses direction again and enters the replaceable filter element through the center portion of the discharge tubes. The air is filtered once more as it passes through the pleats of the impregnated paper element before leaving the outlet port of the cleaner housing.

An air cleaner restriction indicator (Fig. 10) may be attached near the outlet side of the cleaner. As the restriction in the cleaner increases, suction created will pull the indicator plunger upward. A brightly colored card, attached to the plunger and visible through a small window in the indicator, will indicate the relative amount of air restriction in the cleaner. When the card is fully visible, the air cleaner should be cleaned and the indicator reset by pushing the plunger all the way up and then releasing it.

Service

The first stage centrifugal air cleaner tends to be self-cleaning due to the action of the exhaust gas aspirator. However, it should be inspected and any accumulated foreign material removed during the periodic replacement of the impregnated paper filter element. Overloading of the paper element will not cause dirt particles to by-pass the filter and enter the engine, but will result in starving the engine for air.

The filter element may be replaced as follows:

1. Disconnect the flexible aspirator hose at the dust bin of the air cleaner.

2. Loosen the wing nuts on the filter fasteners and swing the retaining bolts away from the cleaner.

3. Lift the cleaner away from the housing and inspect it. Clean out any accumulated foreign material.

4. Withdraw the paper filter element and discard it.

5. Install a new filter element. New sealing gaskets are provided with the element to insure a positive air seal at all times.

6. Install the cleaner and secure it in place with the fasteners.

7. Connect the aspirator hose to the dust bin, making sure the connection is air tight.

AIR SILENCER

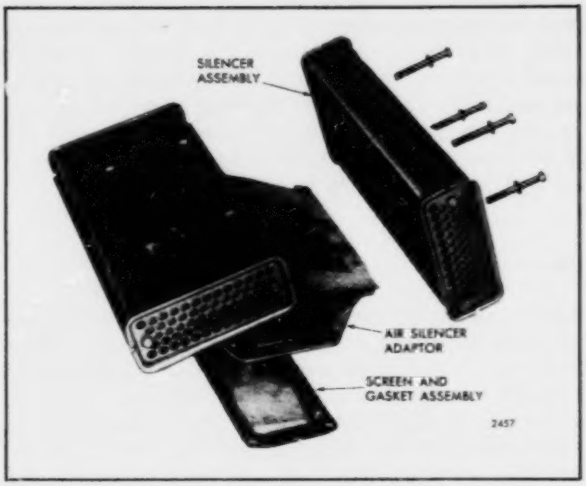


Fig. 11 - Silencer Assembly

The air silencer (Fig. 11), used on some marine models, is bolted to the air intake side of the blower housing. The silencer has a perforated steel partition welded in place parallel with the outside faces, enclosing flame proof, felted cotton waste which serves as a silencer for air entering the blower.

While no servicing is required on the air silencer proper, it may be removed when necessary to replace the air intake screen. This screen is used to filter out any large foreign particles which might seriously damage the blower assembly.

AIR BOX DRAINS

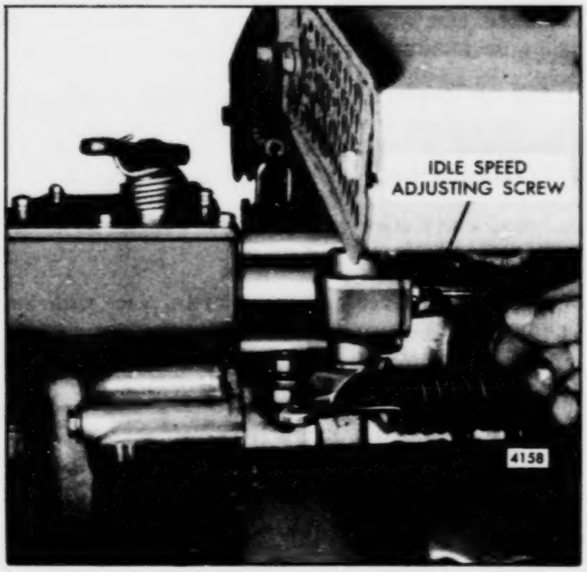


Fig. 12 - Air Box Drains

In normal operation, a slight amount of vapor from the air condenses and settles at the bottom of the air box. This condensation is drained through air box drain tubes (Fig. 12) which direct the expelled air and vapor down and away from the engine.

Air box drains must be open at all times, otherwise water and oil may accumulate in the air box and be drawn into the cylinders with the incoming fresh air. Therefore, periodic checks should be made to ensure they are open. Remove the air box covers and examine the air box floor for oil or an accumulation of water. If oil or water is found, wipe the air box dry with clean rags and remove and clean the air box drain tubes.

CRANKCASE VENTILATION

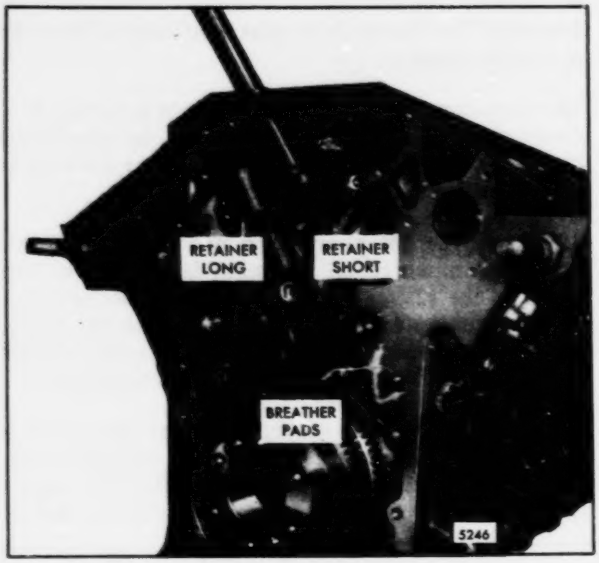

RETAINER LONG
RETAINER SHORT
BREATHER PADS
5246

Fig. 13 - Breather Pads and Retainers Installed in Cylinder Block

Harmful vapors which may be formed within the engine are removed from the crankcase, gear train, and valve compartment by a continuous pressurized ventilation system.

Breathing is through two openings in the rear main bearing bulkhead of the crankcase, which connects to a chamber. Two crimped-steel mesh breather pads, which cover the openings (Fig. 13), filter out the oil as the vapors pass into the chamber.

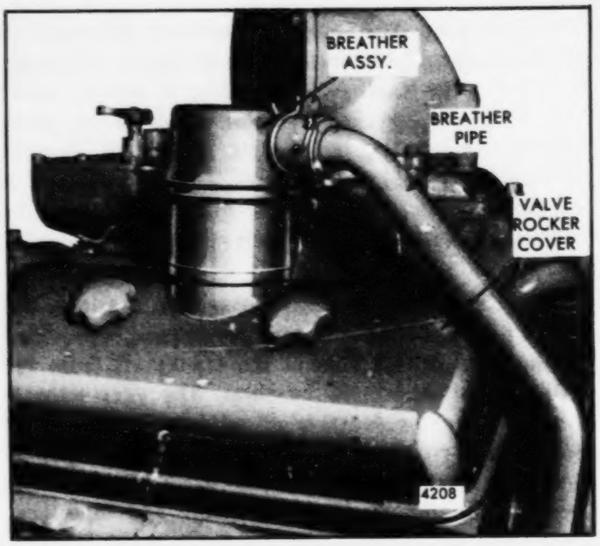

BREATHER ASSY.
BREATHER PIPE
VALVE ROCKER COVER
4208

Fig. 14 - Typical Mounting of Breather Assemly on Valve Rocker Cover

A breather pipe is pressed into or flange mounted on top of the cylinder block to provide an exit for the crankcase vapors.

Some engines have an additional breather assembly mounted on the flywheel housing or on one of the valve rocker covers (Fig. 14).

LUBRICATING SYSTEM

The lubricating oil systems schematically illustrated in Figs. 15, 16 and 17 consist of an oil pump, oil cooler, a full-flow oil filter, by-pass valves at the oil cooler and filter and pressure regulator valves at the pump and in the cylinder block main oil gallery. Positive lubrication is ensured at all times by this system. A by-pass oil filter may also be incorporated into the lubricating system at the owner's option.

Oil for lubricating the connecting rod bearings and piston pins and for cooling the piston head is provided through the drilled hole in the crankshaft from the adjacent forward main bearings. The gear train is lubricated by the overflow of oil from the camshaft pocket through a connecting passage into the flywheel housing. A certain amount of oil spills into the flywheel housing from the camshaft and idler gear bearings. The blower drive gear is lubricated from the rear of the blower.

The oil pump on the 6 and 8V engines is driven by a pump drive hub on the front end of the crankshaft and consists of a large and small spur gear meshing in a cavity inside the crankshaft cover.

The gear-type oil pump used on the 12 and 16V engines is mounted on the main bearing caps. The pump on the 12V engine is driven from the front end of the crankshaft and on the 16V engine the pump, which is mounted on the No. 9 and 10 main bearing caps, is driven from the rear end of the crankshaft.

The pressure regulator valve, located at the end of a vertical oil gallery in the front of the cylinder block, maintains a stabilized oil pressure. The 16V engine has two pressure regulator valves located at the ends of

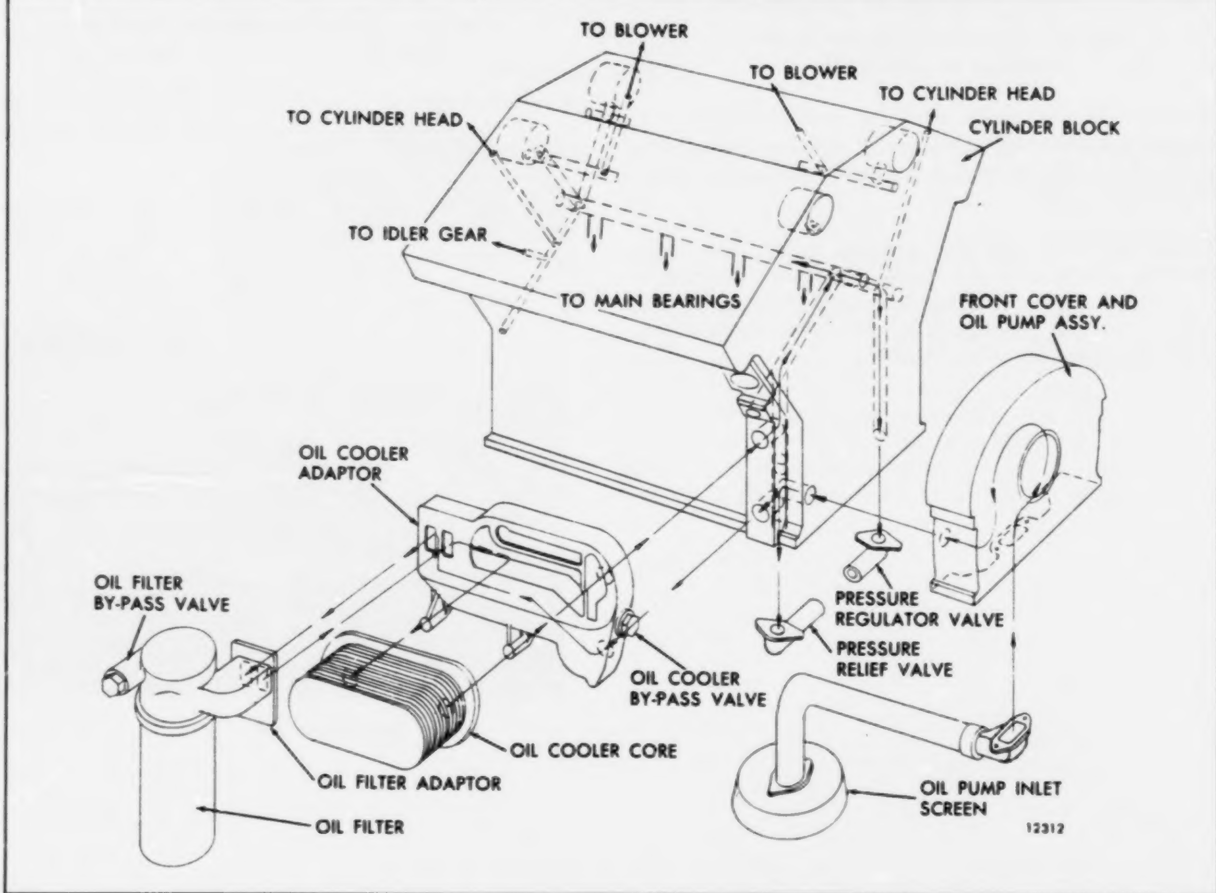

TO BLOWER
TO BLOWER
TO CYLINDER HEAD
TO CYLINDER HEAD
CYLINDER BLOCK
TO IDLER GEAR
TO MAIN BEARINGS
FRONT COVER AND OIL PUMP ASSY.
OIL COOLER ADAPTOR
OIL FILTER BY-PASS VALVE
PRESSURE REGULATOR VALVE
PRESSURE RELIEF VALVE
OIL COOLER BY-PASS VALVE
OIL COOLER CORE
OIL FILTER ADAPTOR
OIL PUMP INLET SCREEN
OIL FILTER
12312

Fig. 15 - Schematic Diagram of Typical 6V and 8V Lubricating Systems

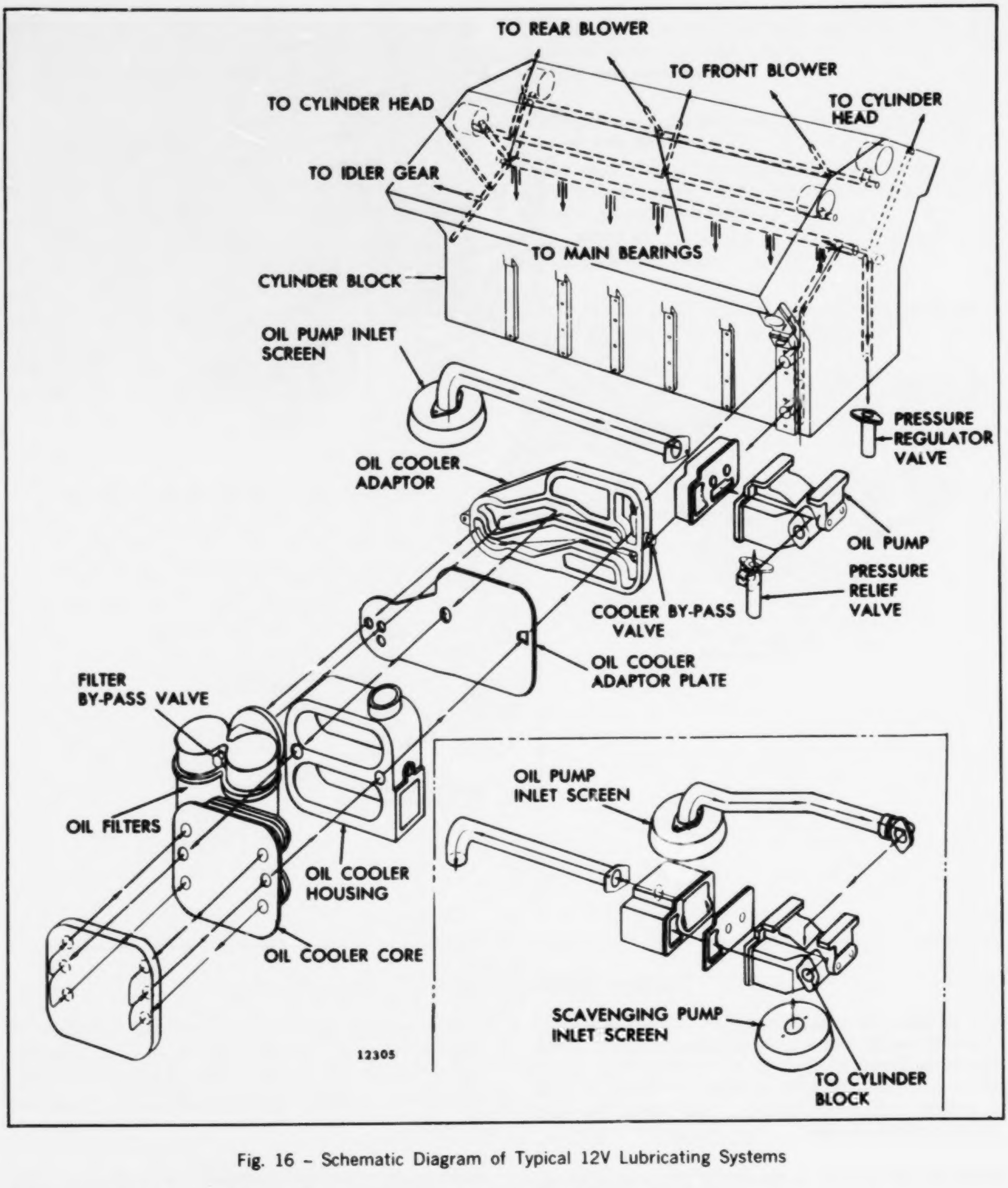

TO REAR BLOWER
TO FRONT BLOWER
TO CYLINDER HEAD
TO CYLINDER HEAD
TO IDLER GEAR
TO MAIN BEARINGS
CYLINDER BLOCK
OIL PUMP INLET SCREEN
PRESSURE REGULATOR VALVE
OIL COOLER ADAPTOR
OIL PUMP
PRESSURE RELIEF VALVE
COOLER BY-PASS VALVE
OIL COOLER ADAPTOR PLATE
FILTER BY-PASS VALVE
OIL FILTERS
OIL COOLER HOUSING
OIL COOLER CORE
OIL PUMP INLET SCREEN
SCAVENGING PUMP INLET SCREEN
TO CYLINDER BLOCK
12305

Fig. 16 – Schematic Diagram of Typical 12V Lubricating Systems

the vertical oil galleries. When the oil pressure at the regulator valve(s) exceeds 50 psi (345 kPa), the valve(s) open and discharge the excess oil to the sump.

Oil Filters

Engines are equipped with a full-flow type lubricating oil filter. If additional filtering is required, a by-pass

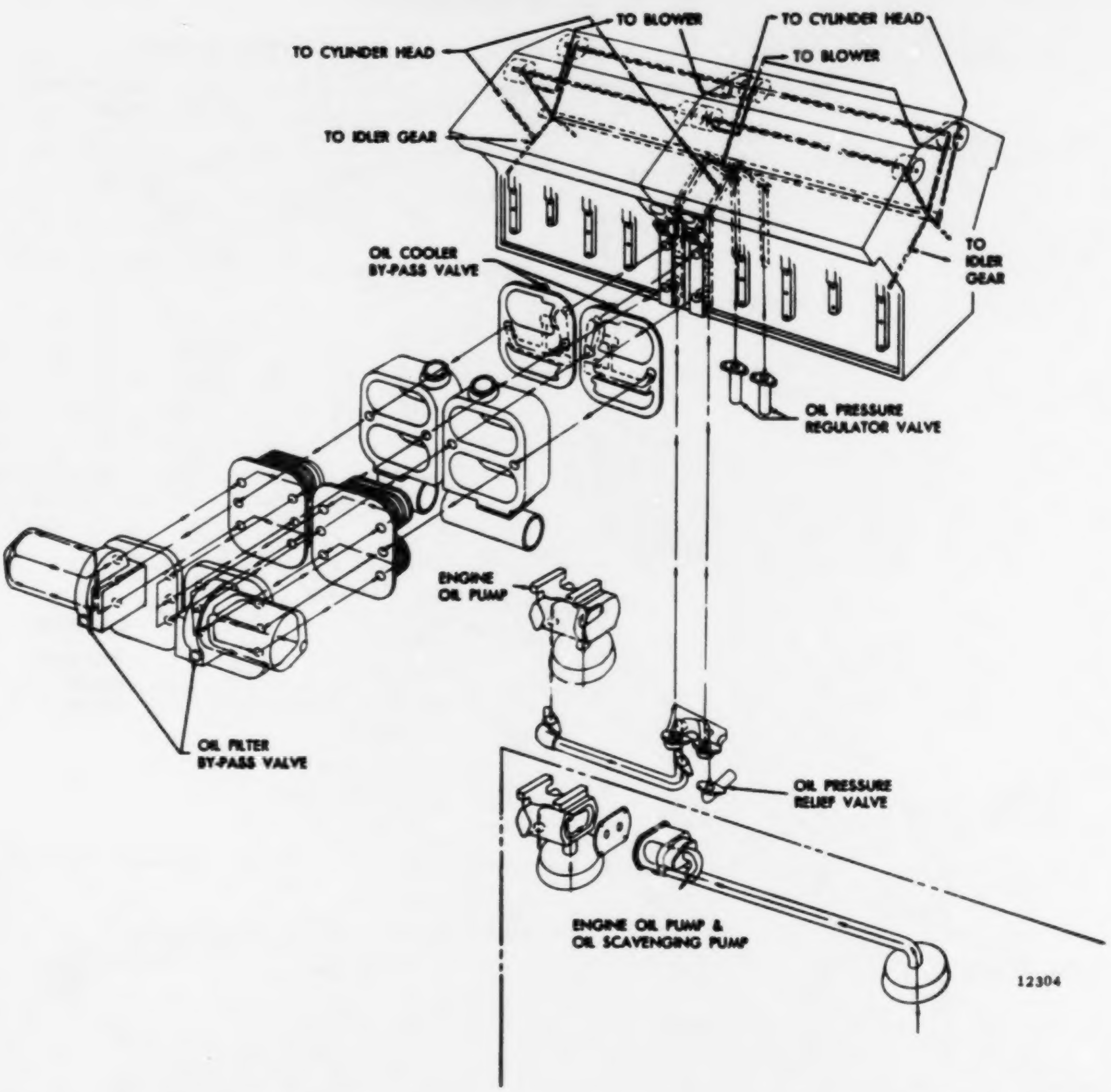

TO CYLINDER HEAD
TO BLOWER
TO CYLINDER HEAD
TO BLOWER
TO IDLER GEAR
TO IDLER GEAR
OIL COOLER BY-PASS VALVE
OIL PRESSURE REGULATOR VALVE
ENGINE OIL PUMP
OIL FILTER BY-PASS VALVE
OIL PRESSURE RELIEF VALVE
ENGINE OIL PUMP & OIL SCAVENGING PUMP
12304

Fig. 17 - Schematic Diagram of Typical 16V Lubrication System

type oil filter may also be installed. The full-flow filter assembly can be remotely mounted or mounted on the engine as shown in Fig. 18. A by-pass valve, which opens at 15 psi (103 kPa), is located in the filter base to ensure engine lubrication in the event the filter should become plugged.

All of the oil supplied to the engine passes through the full-flow filter that removes the larger foreign particles without restricting the normal flow of oil.

The by-pass filter assembly, when used, continually filters a portion of the lubricating oil that is being bled off the oil gallery when the engine is running. Eventually all of the oil passes through the filter, filtering out minute foreign particles that may be present.

Some engines may be equipped with a by-pass filter assembly consisting of two filter elements, each enclosed in a shell which is mounted on a single base. An oil passage in the filter base connects the two annular spaces surrounding both filter elements.

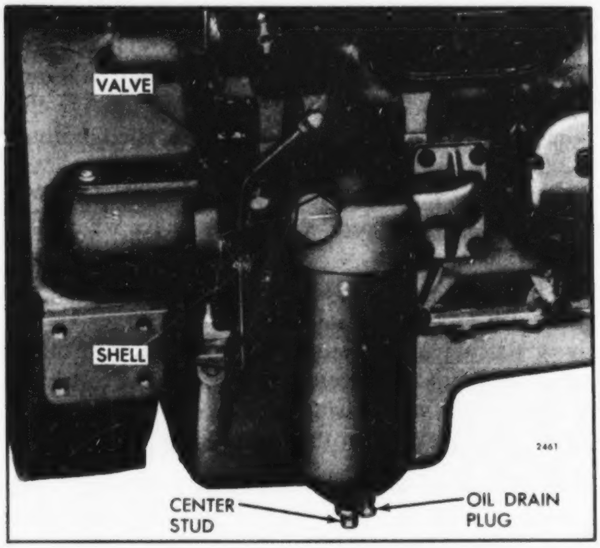


Fig. 18 - Typical Full-Flow Filter Mounting

The full flow and by-pass filter elements should be replaced, each time the engine oil is changed, as follows:

1. Remove the drain plug and drain the oil (Fig. 18).

2. The filter shell, element and stud may be detached as an assembly, after removing the center stud from the base. Discard the gasket.

3. Clean the filter base.

4. Discard the used element, wipe out the filter shell and install a new element on the center stud.

5. Place a new gasket in the filter base, position the shell and element assembly on the gasket and tighten the center stud carefully to prevent damaging the gasket or center stud.

6. Install the drain plug and, after the engine is started, check for oil leaks.

COOLING SYSTEM

To effectively dissipate the heat generated by the engine, one of three different types of cooling systems is used on a V-71 engine; radiator and fan, heat exchanger and raw water pump, or keel cooling. Each system is provided with a centrifugal type water pump that circulates the engine coolant. Each system incorporates thermostats to maintain a normal engine operating temperature of 160-185°F (71-85°C). A typical cooling system is illustrated in Fig. 19.

Radiator and Fan Cooling

Coolant is drawn from the lower portion of the radiator by the water pump and is forced through the oil cooler housing and into the cylinder block. From the cylinder block the coolant passes up through the cylinder heads and, when the engine is at normal operating temperature, through the thermostat housings and into the upper portion of the radiator. Then the coolant passes down a series of tubes where the coolant temperature is lowered by the air stream created by the revolving fan.

Upon starting a cold engine or when the coolant is below operating temperature, the coolant is restricted at the thermostat housing and a by-pass provides water circulation within the engine during the warm-up period.

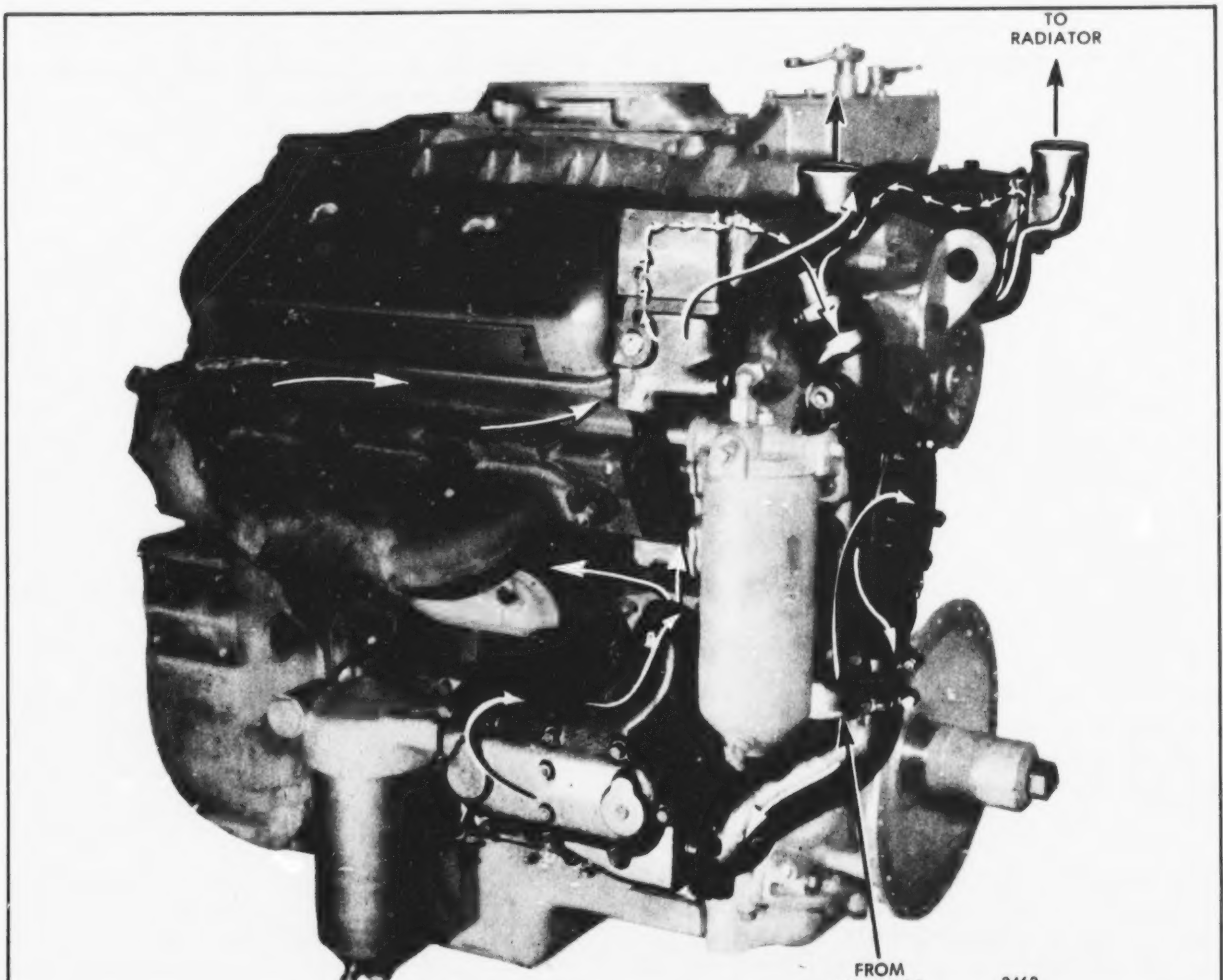


Fig. 19 - Cooling System

Heat Exchanger Cooling

In the heat exchanger cooling system, the coolant is drawn by the fresh water pump from the heat exchanger and is forced through the engine oil cooler, cylinder block, cylinder heads, exhaust manifolds and to the thermostat housings. A by-pass tube from the thermostat housings to the inlet side of the water pump permits circulation of the coolant through the engine while the thermostats are closed. When the thermostats open, the coolant can flow through the heat exchanger and then, after being cooled, to the engine fresh water pump for re-circulation.

While passing through the core of the heat exchanger, the coolant temperature is lowered by raw water which is drawn by the raw water pump from an outside supply. The raw water enters the heat exchanger at one side and is discharged at the opposite side.

To protect the heat exchanger element from electrolytic action, a zinc electrode is located in both the heat exchanger inlet elbow and the raw water pump inlet elbow and extends into the raw water passage.

The length of time a heat exchanger will function satisfactorily before cleaning will be governed by the kind of coolant used in the engine and the kind of raw water used. Soft water plus rust inhibitor or high boiling point type antifreeze should be used as the engine coolant.

When foreign deposits accumulate in the heat exchanger, to the extent that cooling efficiency is impaired, such deposits can, in most instances, be removed by circulating a flushing compound through the fresh water circulating system without removing the heat exchanger. If this treatment does not restore the engine's normal cooling characteristics, contact an authorized *Detroit Diesel Allison Service Outlet.*

Keel Cooling

In the keel cooling system, the coolant is drawn by the fresh water pump from the keel cooler and is forced through the engine oil cooler, cylinder block, cylinder heads, exhaust manifolds and to the thermostat housings. A by-pass tube from the thermostat housings to the inlet side of the water pump permits circulation of coolant through the engine while the thermostats are closed. When the thermostats open, the coolant can flow through the keel cooling coils and then to the suction side of the fresh water pump for re-circulation.

The heat of the engine coolant is transferred through the coils of the keel cooler to the surrounding water.

ENGINE COOLING SYSTEM MAINTENANCE

Engine Coolant

The function of the engine coolant is to absorb the heat, developed as a result of the combustion process in the cylinder, from the component parts such as exhaust valves, cylinder liners, and pistons which are surrounded by water jackets. In addition, the heat absorbed by the oil is also removed by the engine coolant in the oil-to-water cooler.

COOLING SYSTEM CAPACITY
(BASIC ENGINE)

Engine	Former Block		*WBP Block	
	gallons	litres	gallons	litres
6V	5-1/2	21	7	27
8V	7-3/4	29	10	38
12V	101/2	40	13-3/4	52
16V	15-1/2	59	19-3/4	75

*Water-below-port cylinder block

TABLE 1

For the recommended coolant, refer to the section on *Engine Coolant.*

Cooling System Capacity

The capacity of the basic engine cooling system (cylinder block, head, water manifold, thermostat housing and oil cooler housing) is shown in Table 1.

To obtain the complete amount of coolant in the cooling system of a unit, the additional capacity of the radiator, hoses, etc. must be added to the capacity of the basic engine. The capacity of radiators and related equipment should be obtained from the equipment supplier.

Fill Cooling System

Before starting the engine, close all of the drain cocks and fill the cooling system with water. If the unit has a raw water pump, it should also be primed, since operation without water may cause impeller failure. The use of clean, soft water will eliminate the need for de-scaling solutions to clean the cooling system. A hard, mineral-laden water should be made soft by using water softener chemicals before it is poured into the cooling system. These water softeners modify the minerals in the water and greatly reduce or eliminate the formation of scale.

Start the engine and, after the normal operating temperature has been reached, allowing the coolant to expand to its maximum, check the coolant level. The coolant level should be within 2" of the top of the filler neck.

Should a daily loss of coolant be observed, and there are no apparent leaks, there is a possibility of gases leaking past the cylinder head water seal rings into the cooling system. The presence of air or gases in the cooling system may be detected by connecting a rubber tube from the overflow pipe to a water container. Bubbles in the water in the container during engine operation will indicate this leakage. Another method for observing air in the cooling system is by inserting a transparent tube in the water outlet line.

Drain Cooling System

The engine coolant is drained by opening the cylinder block and radiator (heat exchanger) drain cocks and removing the cooling system filler cap. The removal of the cooling system filler cap permits air to enter the cooling passages and the coolant to drain completely from the system.

Drain cocks are located on each side of the cylinder block at both the front and rear of the engine. The drain cocks at the rear of the engine are below the exhaust manifold. The front surface of the cylinder block has drain cocks on each side above the engine front cover.

In addition to the drains on the block, the oil cooler housing has a drain cock at the extreme bottom. Radiators and other components that do not have a drain cock are drained through the oil cooler housing drain cock.

To ensure that all of the coolant is drained completely from a unit, all cooling system drains should be opened. Should any entrapped water in the cylinder block or radiator freeze, it will expand and may cause damage. When freezing weather is expected, drain all units not adequately protected by antifreeze. Leave all drain cocks open until refilling the cooling system.

Marine engine exhaust manifolds are cooled by the same coolant used in the engine. Whenever the engine cooling system is drained, open the exhaust manifold drain cocks.

Raw water pumps are drained by loosening the cover attaching screws and tapping the cover gently to loosen it. After the water has drained, tighten the screws.

Flushing Cooling System

The cooling system should be flushed each spring and fall. The flushing operation cleans the system of antifreeze solution in the spring and removes the summer rust inhibitor in the fall, preparing the cooling system for a new solution. The flushing operation should be performed as follows:

1. Drain the previous season's solution from the engine.

2. Refill the cooling system with soft clean water. If the engine is hot, fill slowly to prevent rapid cooling and distortion of the engine castings.

3. Start the engine and operate it for 15 minutes to circulate the water thoroughly.

4. Drain the cooling system completely.

5. Refill the system with the solution required for the coming season.

Cooling System Cleaners

If the engine overheats, and the fan belt tension and water level have been found to be satisfactory, clean and flush the entire cooling system. Remove scale formation by using a reputable and safe de-scaling solvent. Immediately after using the de-scaling solvent, neutralize the system with the neutralizer. It is important that the directions printed on the container of the de-scaler be thoroughly read and followed.

After the solvent and neutralizer have been used, completely drain the engine and radiator and reverse-flush before filling the system.

Reverse-Flushing

After the engine and radiator have been thoroughly cleaned, they should be reverse-flushed. The water pump should be removed and the radiator and engine reverse-flushed separately to prevent dirt and scale deposits clogging the radiator tubes or being forced through the pump. Reverse-flushing is accomplished by hot water, under air pressure, being forced through the cooling system in a direction opposite to the normal flow of coolant, loosening and forcing scale deposits out.

The radiator is reverse-flushed as follows:

1. Remove the radiator inlet and outlet hoses and replace the radiator cap.

2. Attach a hose at the top of the radiator to lead water away from the engine.

3. Attach a hose to the bottom of the radiator and insert a flushing gun in the hose.

4. Connect the water hose of the gun to the water outlet and the air hose to the compressed air outlet.

5. Turn on the water and, when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between air blasts.

> **CAUTION:** Apply air gradually. Do not exert more than 30 psi (207 kPa) air pressure. Too great a pressure may rupture a radiator tube.

6. Continue flushing until only clean water is expelled from the radiator.

The cylinder block and cylinder head water passages are reverse-flushed as follows:

1. Remove the thermostat and the water pump.

2. Attach a hose to the water inlet of the cylinder block to drain the water away from the engine.

3. Attach a hose to the water outlet at the top of the cylinder block and insert the flushing gun in the hose.

4. Turn on the water and, when the water jackets are filled, turn on the air in short blasts, allowing the engine to fill with water between air blasts.

5. Continue flushing until the water from the engine runs clean.

If scale deposits in the radiator cannot be removed by chemical cleaners or reverse-flushing as outlined above, it may be necessary to remove the upper tank and rod out the individual radiator tubes with flat steel rods. Circulate water through the radiator core from the bottom to the top during this operation.

Miscellaneous Cooling System Checks

In addition to the above cleaning procedures, the other components of the cooling system should be checked periodically to keep the engine operating at peak efficiency. The cooling system hoses, thermostats and radiator pressure cap should be checked and replaced if found to be defective.

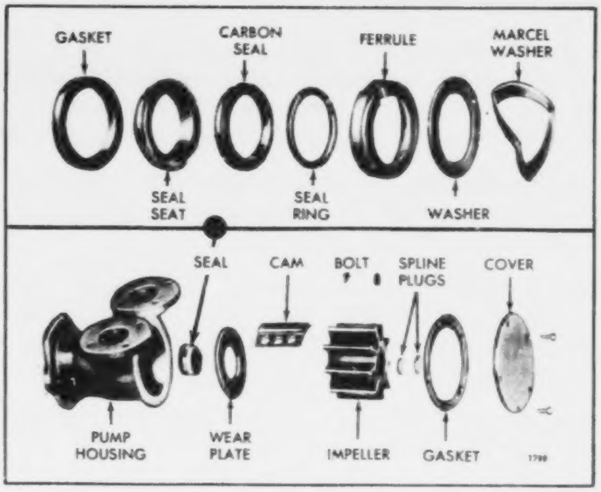


Fig. 20 - Raw Water Pump Details and Relative Location of Parts

When water connection seals and hoses are installed, be sure the connecting parts are properly aligned and the seal or hose is in its proper position before tightening the clamps. All external leaks should be corrected as soon as detected.

The fan belt must be checked and adjusted, if necessary, to provide the proper tension and the fan shroud must be tight against the radiator core to prevent re-circulation of air which may lower the cooling efficiency.

Water Pump

The centrifugal type water pump is mounted on the engine front cover and is driven by a front camshaft gear. This pump circulates the engine coolant through the cylinder block, cylinder head, heat exchanger or radiator and the oil cooler.

The pump consists of a bronze impeller secured to a stainless steel shaft with a lock nut. A gear is pressed on the opposite end of the shaft and the shaft turns on two ball bearings. An oil seal is used ahead of the front bearing and a spring-loaded face type water seal is used in back of the impeller. The pump ball bearings are lubricated with oil splashed by the water pump gear.

Contact an authorized *Detroit Diesel Allison Service Outlet* if more information is needed.

Raw Water Pump

A positive displacement raw water pump driven by a coupling from a camshaft circulates raw water through the heat exchanger to lower the temperature of the engine coolant.

The impeller (Fig. 20) is self-lubricated by the water pumped and should be primed before starting the engine.

Rubber spline plugs have been inserted between the end of the drive shaft and cover to reduce the possibility of foreign material working into the splines and causing wear.

Note that the end cover is marked to show the outlet port for RH rotation and the outlet port for LH rotation. Follow these markings when installing the raw water pump to assure proper direction of flow. Also, when installing the inlet elbow or outlet elbow, be sure to use two flat washers on the bolt being installed in the blind hole in the pump housing.

A rotary type seal assembly prevents any leakage along the shaft.

A raw water pump seal failure is readily noticeable by the leakage of water from the openings in the pump housing. These openings, which are located between the pump mounting flange and the inlet and outlet ports, must remain open at all times.

It is possible to replace seal parts and the impeller without removing the pump from the engine.

Use care to prevent scratching the lapped surface of the seal seat or that portion of the shaft which the seal contacts.

The raw water pump seal parts and impeller may be removed and replaced as follows:

1. Remove the cover screws and lift the cover and gasket from the housing (Fig. 20). Note the position of the impeller blades to facilitate reassembly.

2. Grasp a blade at each side of the impeller with pliers and pull the impeller from the shaft. The spline plugs will come out with the impeller.

3. Remove the spline plugs by pushing a screw driver through the impeller from the opposite end.

> **CAUTION:** If the impeller is reusable, care should be exercised to prevent damage to the splined surfaces.

4. Inspect the bond between the neoprene and the metal of the impeller. Check the impeller blades. If they have a permanent set, a new impeller should be used. If the impeller area which rides on the wear plate is damaged, the impeller should be replaced.

5. Insert two wires (each with a hook at one end) between the housing and seal, with the hooks over the edge of the carbon seal. Then pull the seal assembly from the shaft.

6. The seal seat and gasket may be removed in the same manner.

7. Remove the cam bolt and cam.

8. Remove the wear plate and check it for wear and burrs. If the plate is worn or burred, it may be reversed.

9. Install the wear plate. There is a dowel in the pump body, and the wear plate is notched to ensure correct installation.

10. Hold the cam in position and install the cam bolt.

11. If the seal seat and gasket are removed, place the gasket and seal seat over the shaft and press them into position in the seal cavity.

12. Place the seal ring securely in the ferrule and, with the carbon seal and washer correctly positioned against the ferrule, slide the ferrule over the shaft and against the seal seat. Be sure the seal ring is correctly contained within the ferrule so that it grips the shaft.

13. Install the flat washer and then the marcel washer.

14. Compress the impeller blades to clear the offset cam and press the impeller on the splined shaft. The impeller blades must be correctly positioned to follow the direction of rotation.

15. Turn the engine over a few revolutions to position the impeller blades properly. Install the spline plugs.

16. Use a new gasket and install the cover on the housing.

The Jabsco raw water pump is equipped with a synthetic rubber impeller. Since synthetic rubber loses its elasticity at low temperatures, impellers made of natural rubber should be installed when it is necessary to pump raw water that has a temperature below 40 °F (4 °C).

The synthetic rubber impeller must be used when the pump operates with water over 40 °F (4 °C).

ENGINE EQUIPMENT

INSTRUMENT PANEL, INSTRUMENTS AND CONTROLS

The instruments (Fig. 1) generally required in the operation of a diesel engine consist of an oil pressure gage, a water temperature gage, an ammeter and a mechanical tachometer. Also, closely related and usually installed in the general vicinity of these instruments are certain controls consisting of an engine starting switch, an engine stop knob, an emergency stop knob and, on certain applications, the engine hand throttle.

Marine propulsion units are provided with an instrument panel which usually includes an engine oil pressure gage, reverse gear oil pressure gage, water temperature gage, ammeter and a tachometer. The instrument panels are generally mounted some distance from the engine. Illuminated instrument panels are provided for marine applications which require night operations.

Oil Pressure Gage

The oil pressure gage registers the pressure of the lubricating oil in the engine. As soon as the engine is started, the oil pressure gage should start to register. If the oil pressure gage does not register at least the minimum pressure listed under *Running* in the *Engine Operating Instructions*, the engine should be stopped and the cause of low oil pressure determined and corrected before the engine is started again.

Water Temperature Gage

The engine coolant temperature is registered on the water temperature gage.

Ammeter

An ammeter is incorporated into the electrical circuit to show the current flow to and from the battery. After starting the engine, the ammeter should register a high charge rate at rated engine speed. This is the rate of charge received by the battery to replenish the current used to start the engine. As the engine continues to operate, the ammeter should show a decline in charge rate to the battery. The ammeter will not show zero charge rate since the regulator voltage is set higher than the battery voltage. The small current registered prevents rapid brush wear in the battery-charging generator. If lights or other electrical equipment are connected into the circuit, then the ammeter will show discharge when these items are operating and the engine speed is reduced.

Tachometer

A mechanical tachometer is driven by the engine and registers the speed of the engine in revolutions per minute (rpm).

Engine Starting Switch

The engine starting switch is mounted on the instrument panel with the contact button extending through the front face of the panel. The switch is used to energize the starting motor. As soon as the engine starts, release the switch.

Stop Knob

A stop knob is used on most applications to shut the engine down. When stopping an engine, the speed should be reduced to idle and the engine allowed to operate at idle for a few minutes to permit the coolant to reduce the temperature of the engine's moving parts. Then the stop knob should be pulled and held until the engine stops. Pulling on the stop knob manually places the injector racks in the "no-fuel" position. The stop knob should be returned to its original position after the engine stops.

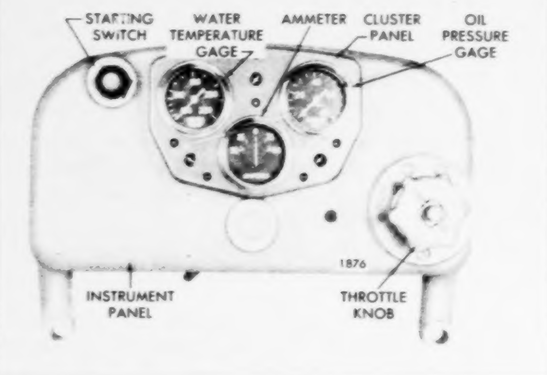


Fig. 1 – Typical Instrument Panel

Emergency Stop Knob

In an emergency, or if after pulling the engine stop knob the engine continues to operate, the emergency stop knob may be pulled to stop the engine. The emergency stop knob, when pulled, will trip the air shut-off valve located between the air inlet housing and the blower and shut off the air supply to the engine. Lack of air will prevent further combustion of the fuel and stop the engine.

The emergency stop knob must be pushed back in after the engine stops so the air shut-off valve can be opened for restarting after the malfunction has been corrected.

Throttle Control

The engine throttle is connected to the governor speed control shaft through linkage. Movement of the speed control shaft changes the speed setting of the governor and thus the engine speed.

ENGINE PROTECTIVE SYSTEMS

MANUAL SHUTDOWN SYSTEM

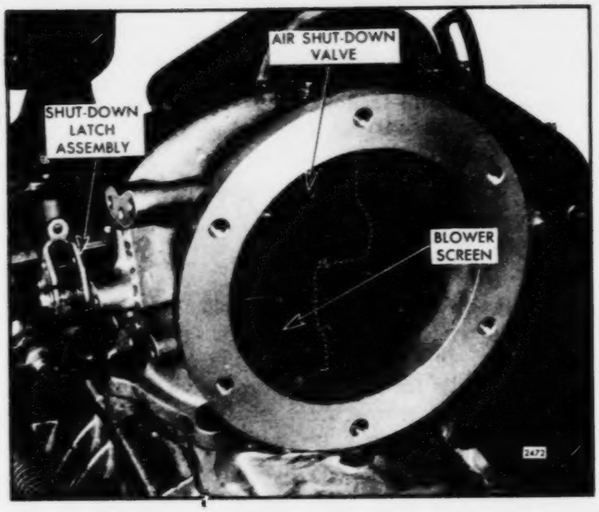


Fig. 2 – Manually Operated Emergency Engine Shutdown Valve Mounting

A manually-operated emergency engine shutdown device, mounted in the air shutdown housing, enables the engine operator to stop the engine in the event an abnormal condition should arise. If the engine continues to run after the engine throttle is placed in the no-fuel position, or if combustible liquids or gases are accidentally introduced into the combustion chamber causing overspeeding of the engine, the shutdown device will prevent damage to the engine by cutting off the air supply and thus stopping the engine. The device consists of a shutdown valve mounted in the air shutdown housing and a suitable operating mechanism (Fig. 2).

The air shut-off valve is retained in the open position by a latch. A wire or cable assembly is used to trip the latch. Pulling the emergency shutdown knob all the way out will stop the engine. After the engine stops, the operator must push the emergency shutdown knob all the way in and manually reset the air shut-off valve before the engine is started again.

AUTOMATIC MECHANICAL SHUTDOWN SYSTEM

The automatic mechanical shutdown system (Fig. 3) is designed to stop the engine if there is a loss of oil pressure, loss of engine coolant, overheating of the engine coolant, or overspeeding of the engine. Engine oil pressure is utilized to activate the components of the system.

A coolant temperature-sensing valve and an adaptor and copper plug assembly are mounted on the exhaust manifold outlet. The power element of the temperature-sensing valve is placed against one end of the copper plug, and the other end of the plug extends into the exhaust manifold. Engine coolant is directed through the adaptor and passes over the power element of the valve. Engine oil, under pressure, is directed through a restricted fitting to the temperature-sensing valve and to an oil pressure actuated bellows located on the air inlet housing.

The pressure of the oil entering the bellows overcomes the tension of the bellows spring and permits the latch to retain the air shut-off valve in the open position. If the oil pressure drops below a predetermined value, the spring in the bellows will release the latch and permit the air shut-off valve to close and thus stop the engine.

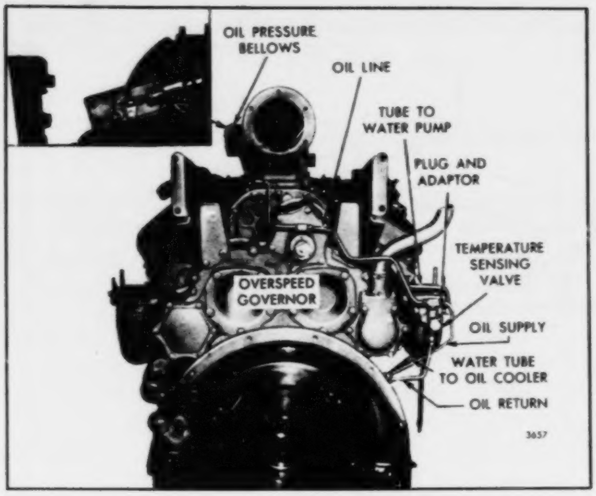


Fig. 3 - Automatic Mechanical Shutdown System Mounting

The overspeed governor (Fig. 4), used on certain applications, consists of a valve actuated by a set of spring-loaded weights. Engine oil is supplied to the valve through a connection in the oil line between the bellows and the temperature-sensing valve. An outlet in the governor valve is connected to the engine oil sump. Whenever the engine speed exceeds the overspeed governor setting, the valve (actuated by the governor weights) is moved from its seat and permits the oil to flow to the engine sump. This decreases the oil pressure to the bellows, thus actuating the shutdown mechanism and stopping the engine.

A restricted fitting, which will permit a drop in oil pressure great enough to actuate the shutdown mechanism, is required in the oil line between the cylinder block oil gallery and the shutdown sensing devices.

Operation

To start an engine equipped with a mechanical shutdown system, first manually open the air shut-off valve and then press the engine starting switch. As soon as the engine starts, the starting switch may be released, but the air shut-off valve must be held in the open position until the engine oil pressure increases sufficiently to permit the bellows to retain the latch in the open position.

During operation, if the engine oil pressure drops below the setting of the pressure sensitive bellows, the spring within the bellows will release the latch and permit the air shut-off valve to close, thus stopping the engine.

If the engine coolant overheats, the temperature-sensing valve will open and permit the oil in the protective system to flow to the engine crankcase.

The resulting decrease in oil pressure will actuate the shutdown mechanism and stop the engine. Also if the engine loses its coolant, the copper plug will be heated up by the hot exhaust gases passing over it and cause the temperature-sensing valve to open and actuate the shutdown mechanism.

Whenever the engine speed exceeds the overspeed governor setting, the oil in the line flows to the sump, resulting in a decrease in oil pressure. The oil pressure bellows then releases the latch and permits the air shut-off valve to close.

When an engine is stopped by the action of the shutdown system, the engine cannot be started again until the particular device which actuated the shutdown mechanism has returned to its normal position. The abnormal condition which caused the engine to stop must be corrected before attempting to start it again.

Adjustment

The only adjustments necessary in the mechanical shutdown system are the low oil pressure setting of the bellows and the overspeed setting of the overspeed governor or overspeed valve assembly. Replace the temperature-sensing valve when operation is unsatisfactory.

To adjust the low oil pressure setting of the bellows, start and run the engine until the normal operating temperature (160-185°F or 71-85°C) has been reached and the oil pressure has stabilized. Then reduce the engine speed slowly until the bellows disengages the latch on the air shut-off valve and stops the engine. Note the oil pressure at which the shut down occurred. The oil pressure at disengagement should be 5—10 psi (35—69 kPa) at 450—600 rpm; 10—15 psi (69—103 kPa) at 601—1400 rpm; or 15—20 psi (103—138 kPa) at 1401 and above rpm. If adjustment is necessary, loosen the lock nut on the bellows and turn the adjusting screw clockwise to increase the oil pressure setting or counterclockwise to decrease the setting. Hold the adjusting screw and tighten the lock nut when the proper setting has been obtained.

> **NOTE:** Set the bellows disengagement pressure as near as possible to the high end of the pressure range for the low engine speed specified for the engine. For an engine equipped with a dual speed governor, set the bellows disengagement at the lower setting of the engine governor.

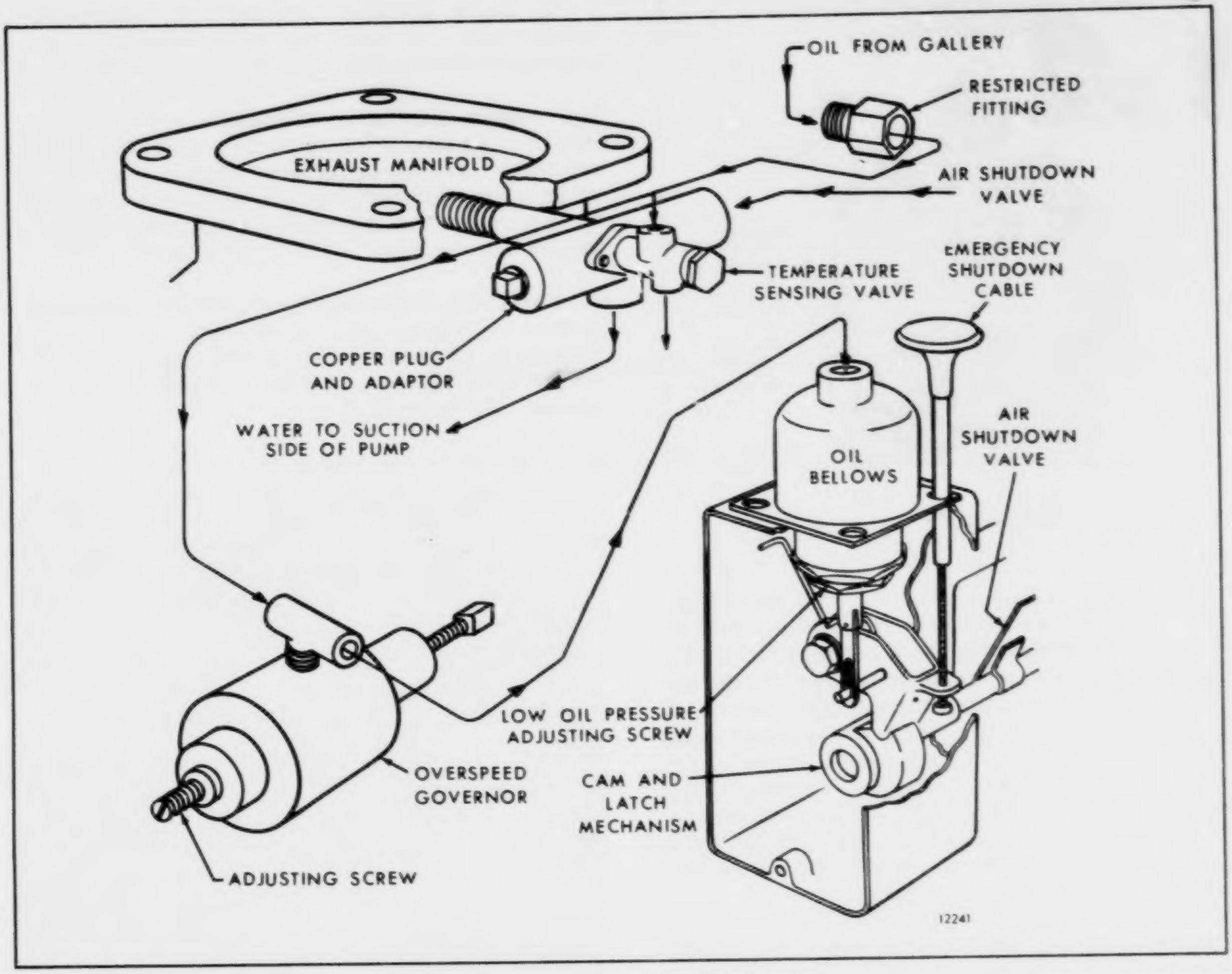

OIL FROM GALLERY
RESTRICTED FITTING
EXHAUST MANIFOLD
AIR SHUTDOWN VALVE
EMERGENCY SHUTDOWN CABLE
TEMPERATURE SENSING VALVE
COPPER PLUG AND ADAPTOR
WATER TO SUCTION SIDE OF PUMP
OIL BELLOWS
AIR SHUTDOWN VALVE
LOW OIL PRESSURE ADJUSTING SCREW
OVERSPEED GOVERNOR
CAM AND LATCH MECHANISM
ADJUSTING SCREW
12241

Fig. 4 - Schematic Drawing of Automatic Mechanical Shutdown System with Overspeed Governor

Check the operation of the engine coolant temperature-sensing valve by placing a cover over the radiator while the engine is operating at part load and note the coolant outlet temperature at which the bellows disengages the air shutdown latch. The air shut-off valve should close and stop the engine within a temperature range of 200-210° F (93-99° C). If the engine is not shut down in this range, replace the temperature-sensing valve. If the engine is shut down below 200° F (93° C), check the coolant flow through the plug and adaptor assembly and, if circulation is satisfactory, replace the temperature-sensing valve.

> **NOTE:** If a premature engine shutdown occurs, check the copper plug. A spring and plunger assembly are used with the current type plug to provide an unobstructed flow of coolant over the temperature-sensing valve element.

The temperature-sensing valve can be bench tested by attaching an air hose (40 psi or 276 kPa air supply) to the oil inlet side and installing a tube from the outlet side to a can of water. Then immerse the power element of the valve in a container of water that is heated and agitated. Check the temperature of the water with a thermometer. Apply air to the valve. The valve should be open, as indicated by the flow of air, at a water temperature of 195-206° F (91-95° C).

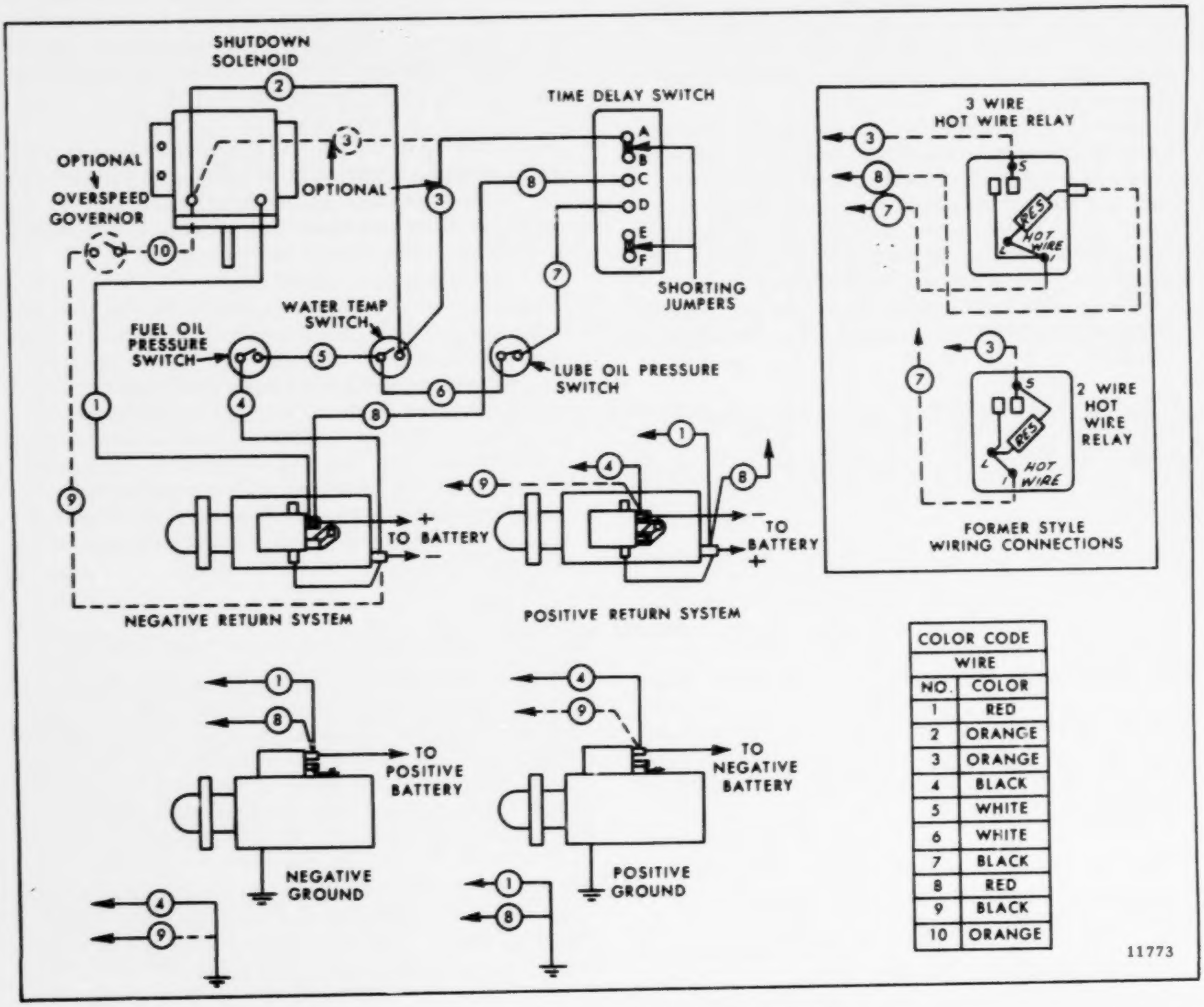
To adjust the overspeed governor, start and run the engine until normal operating temperature is reached. Then increase the engine speed to the desired overspeed shutdown speed. At this speed, the bellows should disengage the air shutdown latch and stop the engine. If necessary, adjust the overspeed governor setting by loosening the lock nut on the adjusting screw at the rear of the governor and turn the screw clockwise to increase the shutdown speed or counterclockwise to decrease the shutdown speed. Then tighten the lock nut, while holding the adjusting screw, when the proper setting is obtained.

AUTOMATIC ELECTRICAL SHUTDOWN SYSTEM

The automatic electrical shutdown system shown in Fig. 5 protects the engine against a loss of coolant, overheating of the coolant, loss of oil pressure, or overspeeding. In the event one of the foregoing conditions arises, a switch will close the electrical circuit and energize the solenoid switch, causing the shutdown solenoid to release the air shutdown latch and stop the engine.

Operation

The electrical circuit is de-energized under normal operating conditions. When the engine is started, one oil pressure switch opens when the oil pressure reaches approximately 5 psi (35 kPa) and the fuel oil pressure switch closes at approximately 20 psi (138 kPa) fuel pressure. As the engine speed increases, the second oil pressure switch opens at approximately 27 psi (186 kPa) and at 1000-1100 rpm, the No. 1 switch in the overspeed governor will close. The water temperature switch remains open.


SHUTDOWN SOLENOID
OPTIONAL
OVERSPEED GOVERNOR
OPTIONAL
TIME DELAY SWITCH
A
B
C
D
E
F
SHORTING JUMPERS
FUEL OIL PRESSURE SWITCH
WATER TEMP SWITCH
LUBE OIL PRESSURE SWITCH
+ TO BATTERY -
TO BATTERY
NEGATIVE RETURN SYSTEM
POSITIVE RETURN SYSTEM
3 WIRE HOT WIRE RELAY
S
RES
HOT WIRE
2 WIRE HOT WIRE RELAY
FORMER STYLE WIRING CONNECTIONS
TO POSITIVE BATTERY
TO NEGATIVE BATTERY
NEGATIVE GROUND
POSITIVE GROUND
1
2
3
4
5
6
7
8
9
10
11773

COLOR CODE	
WIRE	
NO.	COLOR
1	RED
2	ORANGE
3	ORANGE
4	BLACK
5	WHITE
6	WHITE
7	BLACK
8	RED
9	BLACK
10	ORANGE

Fig. 5 - Automatic Electrical Shutdown System Diagram

If the oil pressure drops below 27 psi (186 kPa), the oil pressure switch will close the circuit and energize the shutdown solenoid. This will activate the shutdown mechanism and stop the engine.

A loss of coolant or an increase in coolant temperature to approximately 203° F (94° C) will close the contacts in the water temperature switch, thus closing the electrical circuit and activating the shutdown mechanism.

The water temperature switch consists of a temperature-sensing valve and a micro-switch. The valve contacts a copper plug (heat probe) which extends into the exhaust manifold outlet. Engine water is directed over the power element of the valve and should the water temperature exceed approximately 203° F (94° C), the valve will close the contacts in the micro-switch and energize the shutdown circuit. If a loss of water occurs, the heat of the exhaust gases will be transmitted through the copper plug to the temperature-sensing valve and cause the shutdown circuit to be activated.

If the engine speed exceeds the high speed setting of the overspeed governor, the No. 2 governor switch will close and activate the shutdown mechanism.

When the engine is shut down, the decrease in speed will open the governor switches and the decrease in oil and fuel pressures will close the oil pressure switches and open the fuel pressure switch, thus de-energizing the circuit.

The cause of the abnormal conditions must then be determined and corrected before the engine is started again. Also, the air shut-off valve must be manually reset in the open position before the engine can be started.

Some engines are equipped with an electrically operated automatic shutdown system which incorporates a hot wire relay and one oil pressure switch (Fig. 5).

Since the fuel pressure builds up rapidly, the fuel oil pressure switch could close before the lubricating oil pressure switch opens, thereby effecting a shut down of the engine. The hot wire relay, however, delays the closing of the fuel oil pressure switch for 3 to 10 seconds to enable the lubricating oil pressure to build up and open the oil pressure switch contacts.

When the lubricating oil pressure falls below 10 ± 2 psi (69 ± 14 kPa), the contacts in the oil pressure switch used in this system will close and current will flow to the hot wire relay. The few seconds required to heat the hot wire relay provides sufficient delay to avoid an engine shut down when low oil pressure is caused by a temporary condition such as an air bubble or a temporary overlap in the operation of the oil pressure switch and the fuel oil pressure switch when starting or stopping the engine.

Depending upon the particular shutdown system used, the high water temperature switch may be installed in one of the openings in the water manifold, or the temperature-sensing valve and micro-switch unit may be installed in the exhaust manifold outlet.

In some electrical shutdown applications, the temperature-sensing valve and the copper plug used in the mechanical shutdown system is utilized. The lubricating oil pressure switch is installed in the oil line to the valve. When an increase in water temperature causes the valve to open and permits the oil to flow back to the crankcase, the resulting decrease in oil pressure will close the oil pressure switch and energize the electrical shutdown circuit. Low engine oil pressure will also cause the contacts in the oil pressure switch to close and energize the shutdown circuit.

ALARM SYSTEM

The alarm system shown in Fig. 6 is similar to the automatic electrical shutdown system, but uses a warning bell in place of the air shut-off valve solenoid. The bell warns the engine operator if the engine coolant overheats or the oil pressure drops below the safe operating limit.

When the engine is started and the oil pressure is sufficient to open the oil pressure switch contacts (opening pressure is stamped on the switch cover), the alarm switch must be turned on manually to put the system in operation. The water temperature switch is normally open. Should the engine coolant exceed 200-205° F (93-95° C), the water temperature switch will close the electrical circuit and sound the alarm bell.

Likewise, if the oil pressure drops below the setting of the oil pressure switch, the switch will close and cause the bell to ring. The bell will continue to ring until the engine operator turns the alarm switch off. The alarm switch must also be turned off before a routine stop since the decreasing oil pressure will close the oil pressure switch and cause the bell to ring.

If the alarm bell rings during engine operation, stop the engine immediately and determine the cause of the abnormal condition. Make the necessary corrections before starting the engine again.

An alarm bell may be connected to the electrical shutdown system as shown in Fig. 7. In this system, if

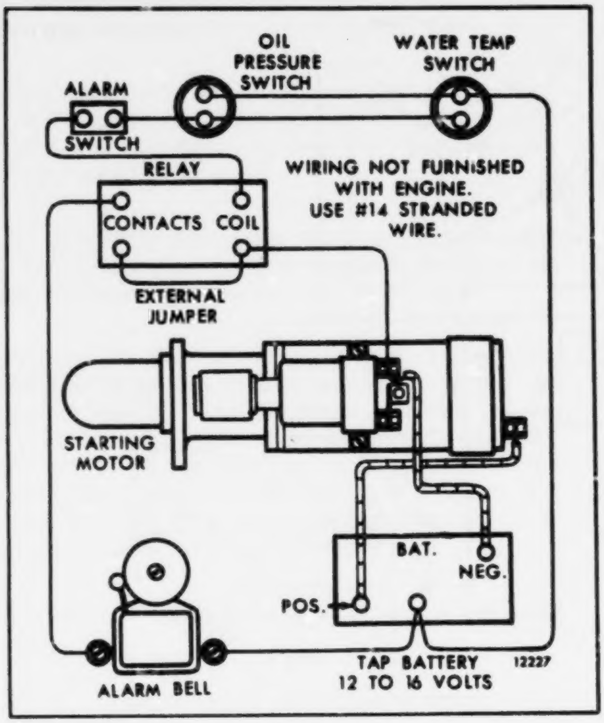

OIL
PRESSURE
SWITCH
WATER TEMP
SWITCH
ALARM
SWITCH
RELAY
CONTACTS
COIL
WIRING NOT FURNISHED WITH ENGINE. USE #14 STRANDED WIRE.
EXTERNAL
JUMPER
STARTING
MOTOR
BAT.
NEG.
POS.
TAP BATTERY
12 TO 16 VOLTS
12227
ALARM BELL

Fig. 6 - Alarm System Wiring Diagram

an abnormal condition occurs, the engine will be stopped automatically and the alarm bell will ring to notify the operator. The bell will continue to ring until the operator pushes the reset button on the drop relay.

The alarm system illustrated in Fig. 8 utilizes the temperature-sensing valve and the low oil pressure and overspeed valve used in the mechanical shutdown system.

When the engine is started, the oil pressure switch will open when the oil pressure reaches 10 psi (69 kPa) and the fuel oil pressure switch will close when the fuel pressure reaches 20 psi (138 kPa). If overheating or loss of engine coolant occurs, the temperature-sensing valve will open and permit the oil to flow to the crankcase. The resulting drop in oil pressure will permit the contacts in the oil pressure switch to close and complete the electrical circuit to the alarm bell. A loss of engine oil pressure or overspeeding of the engine will cause the oil pressure and overspeed valve to open and activate the alarm system. Once the alarm system is activated, the bell will continue to ring until the engine operator stops the engine.

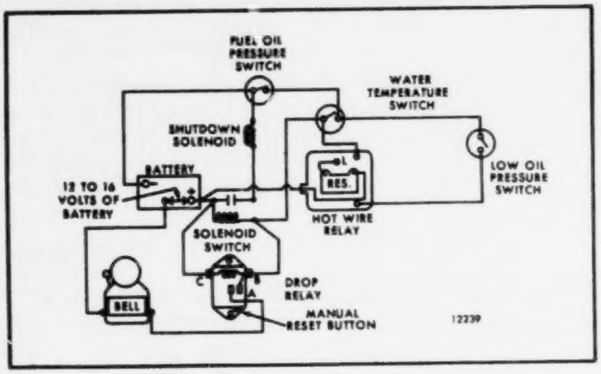

FUEL OIL
PRESSURE
SWITCH
WATER
TEMPERATURE
SWITCH
SHUTDOWN
SOLENOID
BATTERY
12 TO 16
VOLTS OF
BATTERY
RES.
L
LOW OIL
PRESSURE
SWITCH
HOT WIRE
RELAY
SOLENOID
SWITCH
C
B
A
DROP
RELAY
BELL
MANUAL
RESET BUTTON
12239

Fig. 7 - Alarm Bell Connected to Electrical Shutdown System

During a routine engine shut down, the decreasing fuel pressure causes the fuel pressure switch to open the electrical circuit before the decreasing oil pressure can activate the alarm system.

On 16V-71 engines, coolant protection is also obtained through an exhaust probe and adaptor assembly and a temperature switch. In this system, the engine coolant is circulated around the switch power element to prevent the switch from being activated by the heat transfer from the exhaust probe. Therefore, an alarm will occur if coolant flow through the adaptor is interrupted for any reason. The switch will also operate when the engine coolant discharge temperature exceeds 200-205 ° F (93-95 ° C).

The oil pressure switch, mounted in the low oil pressure and overspeed valve (Fig. 8), will be activated to sound the alarm when the engine oil pressure drops below the safe operating pressure. The switch will also detect an engine overspeed. Engine oil is supplied to the valve. Should the engine oil pressure drop below a safe operating value, above 1200 rpm, the valve will operate, dropping the oil pressure at the switch which completes the circuit and sounds the alarm. Below 1200 rpm the oil pressure switch will close whenever the oil pressure is less than the switch setting.

Engine overspeed is detected by the operation of the valve which results in the oil switch closing. The travel of the piston in the valve, which is adjustable, controls the overspeed setting.

The relay is used to prevent damage to the pressure and temperature switches should the current to operate the alarm device be too high.

Should the alarm be activated for any reason, the engine should be stopped immediately and the cause found and corrected before the engine is started again.

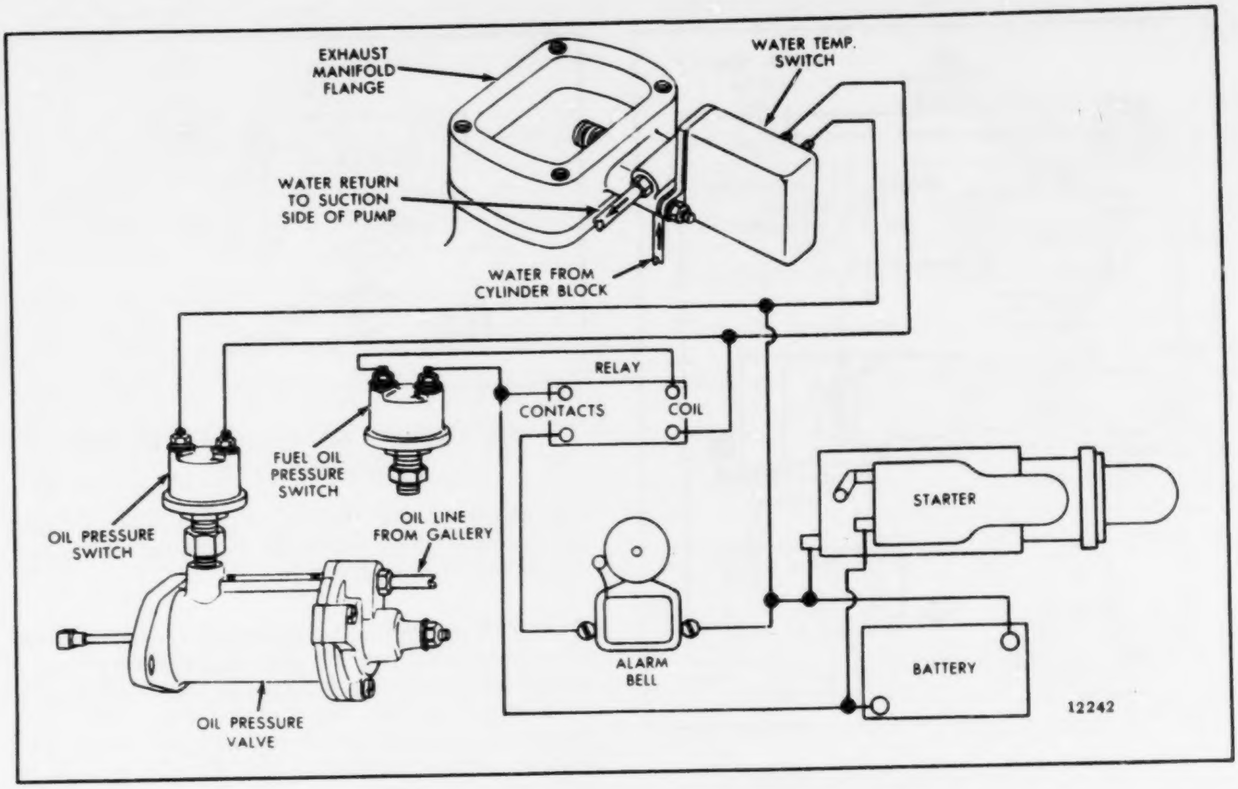

EXHAUST MANIFOLD FLANGE
WATER TEMP. SWITCH
WATER RETURN TO SUCTION SIDE OF PUMP
WATER FROM CYLINDER BLOCK
RELAY
CONTACTS
COIL
FUEL OIL PRESSURE SWITCH
OIL PRESSURE SWITCH
OIL LINE FROM GALLERY
STARTER
ALARM BELL
BATTERY
OIL PRESSURE VALVE
12242

Fig. 8 - Alarm System with Mechanical Sensing Units

STARTING SYSTEMS

ELECTRICAL STARTING SYSTEM

The electrical system on an engine generally consists of a starting motor, starting switch, battery-charging alternator, voltage regulator, storage battery and the necessary wiring. Additional electrical equipment may be installed on the engine at the option of the owner.

Starting Motor

The electric starting motor has an overrunning clutch drive or a Bendix drive assembly. Bendix drive starters are generally used on applications where automatic starting is required, such as standby generator sets. The overrunning clutch drive starters have the solenoid mounted on the starter and have a totally enclosed shifting mechanism.

Starter Switch

To start the engine, a switch is used to energize the starting motor. Release the switch immediately after the engine starts.

Battery-Charging Alternator

A battery-charging alternator is introduced into the electrical system to provide a source of electrical current for maintaining the storage battery in a charged condition and to supply sufficient current to carry any other electrical load requirements up to the rated capacity of the alternator.

Alternator Precautions

Precautions must be taken when working on or around an A.C. generator (alternator). The diodes and transistors in the alternator circuit are very sensitive and can be easily destroyed.

Avoid grounding the output wires or the field wires between the alternator and the regulator. Never run an alternator on an open circuit.

Grounding an alternator's output wire or terminals, which are always **hot** regardless whether or not the engine is running, and accidental reversing of the battery polarity will destroy the diodes. Grounding the field circuit will also result in the destruction of the diodes. Some voltage regulators provide protection against some of these circumstances. However, it is recommended that extreme caution be used.

Accidentally reversing the battery connections must be avoided.

Never disconnect the battery while an alternator is in operation. Disconnecting the battery will result in damage to the diodes, due to the momentary high voltage and current generated by the rapid collapse of the magnetic field surrounding the field windings.

In marine applications which have two sets of batteries, switching from one set of batteries to the other while the engine is running will momentarily disconnect the batteries and result in damage to the alternator diodes.

If a booster battery is to be used, the batteries must be connected correctly (negative to negative and positive to positive).

Never use a fast charger with the battery connected, or as a booster for battery output.

Never attempt to polarize an alternator. Polarization is not necessary and is harmful.

The alternator diodes are also sensitive to heat, and care must be exercised to prevent damage to them from soldering irons, etc.

If faulty operation of an alternator occurs on an engine equipped with an insulated starting motor, check to be sure that a ground strap is present and is correctly installed.

Regulator

A regulator is incorporated in the electrical system to regulate the voltage and current output of the battery-charging alternator and to help maintain a fully charged storage battery.

Storage Battery

The lead-acid storage battery is an electrochemical device for converting chemical energy into electrical energy.

The battery has three major functions:

1. It provides a source of electrical power for starting the engine.

2. It acts as a stabilizer to the voltage in the electrical system.

3. It can, for a limited time, furnish current when the electrical demands of the unit exceed the output of the alternator.

The battery is a perishable item which requires periodic servicing. A properly cared for battery will give long and trouble-free service.

1. Check the level of the electrolyte regularly. Add water if necessary, but do not overfill. Overfilling can cause poor performance or early failure.

2. Keep the top of the battery clean. When necessary, wash with a baking soda solution and rinse with fresh water. Do not allow the soda solution to enter the cells.

3. Inspect the cables, clamps and hold-down bracket regularly. Clean and re-apply a light coating of grease when needed. Replace corroded, damaged parts.

4. Use the standard, quick in-the-unit battery test as the regular service test to check battery condition.

5. Check the electrical system if the battery becomes discharged repeatedly.

If the engine is to be stored for more than 30 days, remove the battery. The battery should be stored in a cool, dry place. Keep the battery fully charged and check the level of the electrolyte regularly,

The *Lubrication and Preventive Maintenance* section of this manual covers the servicing of the starting motor and alternator.

Consult an authorized *Detroit Diesel Allison Service Outlet* for information regarding the electrical system.

HYDRAULIC STARTING SYSTEM (HYDROSTARTER)

The hydrostarter system schematically illustrated in Fig. 9 is a complete hydraulic system for starting internal combustion engines. The system is automatically recharged after each start, and can be manually recharged. The starting potential remains during long periods of inactivity, and continuous exposure to hot or cold climates has no detrimental effect upon the hydrostarter system. Also, the hydrostarter torque for a given pressure remains substantially the same regardless of the ambient temperature.

The hydrostarter system consists of a reservoir, an engine-driven charging pump, a hand pump, a piston type accumulator, a starting motor and connecting hoses and fittings.

Operation

Hydraulic fluid flows by gravity, or a slight vacuum, from the reservoir to either the engine-driven pump or the hand pump inlet. Fluid discharging from either pump outlet at high pressure flows into the accumulator and is stored at 3250 psi (22 393 kPa) under the pressure of compressed nitrogen gas.

When the starter is engaged with the engine flywheel ring gear and the control valve is opened, fluid under pressure is forced out of the accumulator, by the expanding nitrogen gas, and flows into the starting motor which rapidly accelerates the engine to a high cranking speed. The used fluid returns directly to the reservoir from the starter.

The engine-driven charging pump runs continuously during engine operation and automatically recharges the accumulator. When the required pressure is attained in the accumulator, a valve within the pump body opens and the fluid discharged by the pump is by-passed to the reservoir. The system can be shutdown and the pressure in the accumulator will be maintained.

The precharge pressure of the accumulator is the pressure of the nitrogen gas with which the accumulator is initially charged. This pressure must be checked before the system pressure is raised for the initial engine start. To check the precharge pressure, open the relief valve, on the side of the hand pump, approximately 1/2 turn, allowing the pressure gage to return to zero. Close the relief valve and pump several strokes on the hand pump. The gage should show a rapid pressure rise from zero to the nitrogen precharge pressure, where it will remain without change for several additional strokes of the pump.

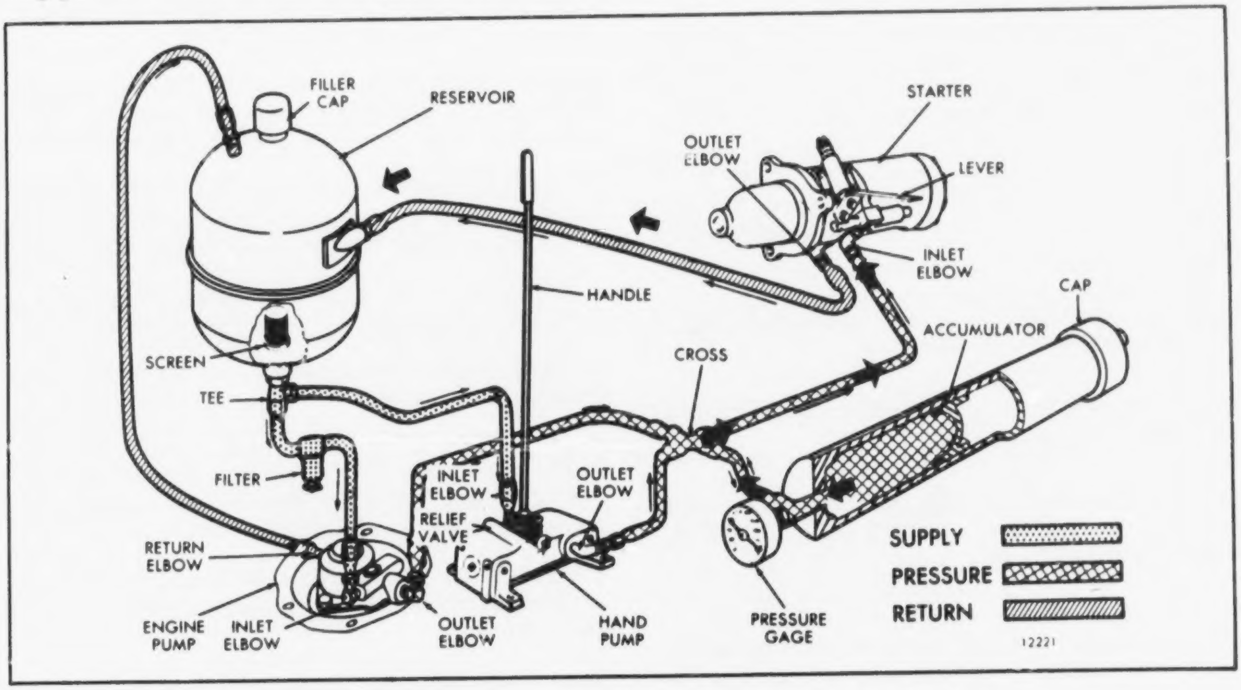


Fig. 9 - Schematic Diagram of Hydrostarter System Showing Oil Flow

Initial Engine Start

Use the hand pump to raise the accumulator pressure. An accumulator pressure of 1500 psi (10 335 kPa) when the ambient temperature is above 40° F (4° C) will provide adequate cranking to start the engine. Between 40° F (4° C) and 0° F (–18° C), 2500 psi (17 225 kPa) should be sufficient. Below 0° F (–18° C), the accumulator should be charged to the maximum recommended pressure. Although the hydrostarter cranks the engine faster than other starting systems, starting aids should be used in cold weather.

> **NOTE:** Use the priming pump to make sure the filters, lines, manifolds and injectors are full of fuel before attempting to start the engine.

For ambient temperatures below 40° F (4° C), use a fluid starting aid. Add the starting fluid just prior to moving the hydrostarter lever and during the cranking cycle as required. Do not wait to add the starting fluid after the engine is turning over, otherwise the accumulator charge may be used up before the engine can start. In this case, the accumulator charge must be replaced with the hand pump.

With the engine controls set for start (throttle at least half-open), push the hydrostarter control lever to simultaneously engage the starter pinion with the flywheel ring gear and to open the control valve. Close the valve quickly when the engine starts, to conserve the accumulator pressure and to prevent excessive over-running of the starter drive clutch assembly.

Remote Control System

The hydrostarter remote control system (Fig. 10) consists of a master cylinder, a pedal, a lever arm, two springs, and a flexible hose. It is an independent hydraulic system using diesel fuel oil as a hydraulic fluid to actuate the hydrostarter control valve by means of the pedal operated master cylinder.

The master cylinder is connected to the control valve on the hydrostarter by a flexible hose. Pressing on the pedal forces the fluid through the hose to the control valve which engages the starter pinion with the engine flywheel ring gear. Release the pedal as soon as the engine starts.

The hydrostarter motor is equipped with a control valve that incorporates a threaded valve housing plug with a 1/8″-27 tapped hole in the center for installation of the flexible hose. A 1/8″-27 pipe plug is installed when the remote control system is not used.

Springs are used to return the master cylinder pedal and the hydrostarter control lever to the off position.

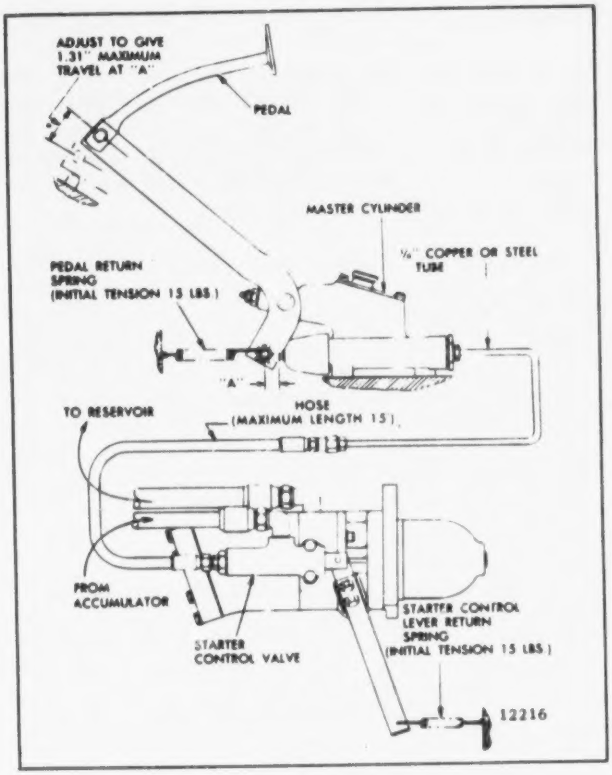

ADJUST TO GIVE 1.31" MAXIMUM TRAVEL AT "A"
PEDAL
MASTER CYLINDER
¼" COPPER OR STEEL TUBE
PEDAL RETURN SPRING (INITIAL TENSION 15 LBS.)
"A"
TO RESERVOIR
HOSE (MAXIMUM LENGTH 15')
FROM ACCUMULATOR
STARTER CONTROL VALVE
STARTER CONTROL LEVER RETURN SPRING (INITIAL TENSION 15 LBS.)
12216

Fig. 10 – Hydrostarter Remote Control System

Filling

Remove the filler cap from the reservoir and add a sufficient quantity of hydraulic fluid (a mixture of 75% diesel fuel and 25% SAE 10 or 30 lubricating oil) to fill the system.

The required amount of hydraulic fluid will vary depending upon the size of the reservoir, length of hydraulic hoses and the size and number of accumulators. The reservoirs are available in 10, 12, 16 and 23 quart (9, 11, 15 and 22 litres) capacities. In a 10 quart (9 litres) capacity reservoir, add approximately 8 quarts (8 litres) of hydraulic fluid, 10 quarts (9 litres) in a 12 quart (11 litres) reservoir, 14 quarts (13 litres) in a 16 quart (15 litres) reservoir or 21 quarts (20 litres) in a 23 quart (22 litres) reservoir.

> **NOTE:** When the accumulator is charged to 3000 psi (20 670 kPa) and all hoses are filled, there should be enough hydraulic fluid remaining in the reservoir to completely cover the screen in the bottom of the reservoir.

Purging

A by-pass valve is located on the inlet side of the hand pump. Loosen the lock nut and rotate this valve approximately one turn counterclockwise with a screw driver. Operate the hand pump for 12 to 15 complete strokes. Do not pump too rapidly. Close the by-pass valve tightly and tighten the lock nut.

1. Move the starter control lever to engage the pinion with the flywheel and open the control valve. While holding the lever in this position, operate the hand pump until the starter has turned several revolutions. Close the control valve. Loosen the swivel hose fitting at the discharge side of the engine-driven pump about two turns. Operate the hand pump to force air out until the oil begins to appear at the loose fitting. Tighten the swivel hose fitting and pressurize the system with the hand pump sufficiently to start the engine.

2. Perform the initial starting instructions under *Preparation for Starting Engine First Time*. Then, with the engine running at least 1500 rpm, purge the engine-driven pump of air. Break the hose connection at the discharge side of the engine-driven pump until a full stream of oil is discharged from the pump. Connect the hose to the pump and alternately loosen and tighten the swivel fitting on the discharge hose until the oil leaking out, when the fitting is loose, appears to be free of air bubbles. Tighten the fitting securely and observe the pressure gage. The pressure should rise rapidly to the accumulator precharge pressure (1250 psi or 813 kPa at 70° F or 21° C), then increase slowly, reaching 2900-3300 psi (19 981-22 737 kPa).

3. After the pressure has stabilized near 3000 psi (20 670 kPa), examine all of the high pressure hoses, connections and fittings for leaks.

4. The engine-driven pump must by-pass oil to the reservoir when the accumulator pressure reaches 2900-3300 psi (19 981-22 737 kPa). To determine whether the pump by-pass valve is operating properly, remove the reservoir filler cap, disconnect the pump by-pass hose at the reservoir, and hold the hose over the open reservoir filler spout. An occasional spurt of oil may be emitted from the hose prior to by-passing. When the by-pass valve opens, a full and continuous stream of oil will flow from the hose. Reconnect the hose to the reservoir and install the filler cap.

5. Fill the reservoir to the proper level.

The hydrostarter remote control system may be purged of air as follows:

1. Fill the master cylinder with fuel oil.

2. Loosen the hose fitting at the hydrostarter control valve.

3. Actuate the master cylinder pedal until all of the air is discharged from the system and a solid stream of fuel oil is being discharged with each stroke.

> **NOTE:** Replenish the fluid in the master cylinder as required during the purging operation.

4. Tighten the hose fitting and check for leaks.

LUBRICATION AND PREVENTIVE MAINTENANCE

Inspect the system periodically for leaks. Primarily, examine the high pressure hoses, connections, fittings and the control valve on the starter. Make certain that the oil level in the reservoir is sufficient to completely cover the screen at the bottom of the tank. Make this check after the accumulator is charged and the engine-driven pump is by-passing oil to the reservoir.

Every 2000 hours, or as conditions warrant, drain the reservoir and remove the screen. Flush out the reservoir and clean the screen and filler cap. Then reinstall the screen.

Remove the bowl and element from the filter in the engine-driven pump supply hose. Wash the bowl and element in clean fuel oil and reassemble the filter.

Release the pressure and drain the remaining hydraulic fluid from the system by disconnecting the hoses from the hydrostarter components. Then reconnect all of the hydraulic hoses.

> **CAUTION:** The oil pressure in the system must be released prior to servicing the hydrostarter motor or other components to prevent possible injury to personnel or equipment.

> **NOTE:** Make sure all hoses and fittings are clean before any connections are made.

Fill the hydrostarter system with new clean fluid.

Lubrication

Remove the hydrostarter from the engine every 2000 hours for lubrication. Before removing the hydrostarter, release the pressure in the system by means of the relief valve in the hand pump. Then remove the three bolts that retain the starting motor to the flywheel housing. Remove the starting motor without disconnecting the hydraulic oil hoses. This will prevent dirt and air from entering the hydraulic system.

Apply a good quality, lightweight grease on the drive clutch pinion to make sure the clutch will slide freely while compressing the spring. Also apply grease to the fingers of the clutch fork and on the spool of the clutch yoke engaged by the fork. This lubrication period may be reduced or lengthened according to the severity of service.

Remove the pipe plug from the starting motor drive housing and saturate the shaft oil wick with engine oil. Then reinstall the plug.

After lubricating, install the starting motor on the flywheel housing and recharge the accumulator with the hand pump.

On engines equipped with a hydraulic remote control system, lubricate the shaft in the master cylinder through the pressure grease fitting every 2000 hours.

Cold Weather Operation

Occasionally, when an engine is operated in regions of very low temperatures, the starter drive clutch assembly may slip when the starter is engaged. If the clutch slips, proceed as follows:

1. Release the oil pressure in the system by opening the relief valve in the hand pump.

> **CAUTION:** The oil pressure in the system must be released prior to servicing the hydrostarter motor or other components to prevent possible injury to personnel or equipment.

2. Disconnect the hydraulic hoses from the starting motor.

3. Remove the three retaining bolts and lock washers and withdraw the starting motor from the flywheel housing.

4. Disassemble the starting motor.

5. Wash the hydrostarter drive clutch assembly in clean fuel oil to remove the old lubricant.

6. When the clutch is free, apply SAE 5W lubricating oil.

7. Reassemble the starting motor and reinstall it on the engine. Then attach a tag to the starter noting the lubricant used in the clutch.

8. Recharge the accumulator with the hand pump.

Marine Application

In addition to the normal hydrostarter lubrication and maintenance instructions, the following special precautions must be taken for marine installations or other cases where equipment is subject to salt spray and air, or other corrosive atmospheres:

1. Clean all exposed surfaces and apply a coat of zinc-chromate primer, followed by a coat of suitable paint.

2. Apply a liberal coating of Lubriplate, type 130AA, or equivalent, to the following surfaces.

   a. The exposed end of the starter control valve and around the control shaft where it passes through the clutch housing.

   b. The exposed ends of the hand pump cam pin.

3. Operate all of the moving parts and check the protective paint and lubrication every week.

Consult an authorized *Detroit Diesel Allison Service Outlet* for any information relating to the hydrostarter system.

COLD WEATHER STARTING AIDS

In a diesel engine, the fuel injected into the combustion chamber is ignited by the heat of the air compressed into the cylinder. However, when starting an engine in extremely cold weather, a large part of the energy of combustion is absorbed by the pistons and cylinder walls and in overcoming the high friction created by the cold lubricating oil.

When the ambient temperature is low, it may be necessary to use an air heater or a starting fluid to assist ignition of the fuel.

> **NOTE:** Starting aids are NOT intended to correct for a low battery, heavy oil, or other conditions which cause hard starting. They are to be used only when other conditions are normal, but the air temperature is too cold for the heat of compression to ignite the fuel-air mixture.

FLUID STARTING AID

The fluid starting aid (Fig. 11) is designed to inject a highly volatile fluid into the air intake system at low ambient temperatures to assist in igniting the fuel oil injected. This fluid is contained in suitable capsules to facilitate handling.

The starting aid consists of a cylindrical capsule container with a screw cap, inside of which a sliding piercing shaft operates. A tube leads from the capsule container to the hand operated pump and another tube leads to the atomizing nozzle threaded into a tapped hole in the air inlet housing.

The capsule container should be mounted in a vertical position and away from any heat.

Start the engine, using the fluid starting aid, as follows:

1. Remove the threaded cap and insert a fluid capsule in an upright position within the container.

> **CAUTION:** The starting fluid is toxic and inflammable. Use caution when handling.

2. Pull the piercing shaft all the way out and install and tighten the cap on the container.

3. Push the piercing shaft all the way down. This will rupture the capsule and fill the container with the starting fluid.

4. Move the engine throttle to the maximum speed position.

5. Engage the starter and at the same time pull the pump plunger all the way out. Push the plunger in slowly, forcing the starting fluid through the atomizing nozzle into the air intake. Continue to push the pump in until the engine starts. If the plunger is not all the way in when the engine starts, push it in slowly until it locks in the IN position.

6. Unscrew the cap and remove the capsule. *Do not leave the empty capsule in the container.*

7. Replace the cap on the capsule container and make sure the piercing shaft is all the way down.

Service

The cold weather fluid starting aid will require very little service. Replace the piston seal packing if the pump leaks. If there is an excessive resistance to pumping, the nozzle may be plugged. Remove the nozzle and clean it.

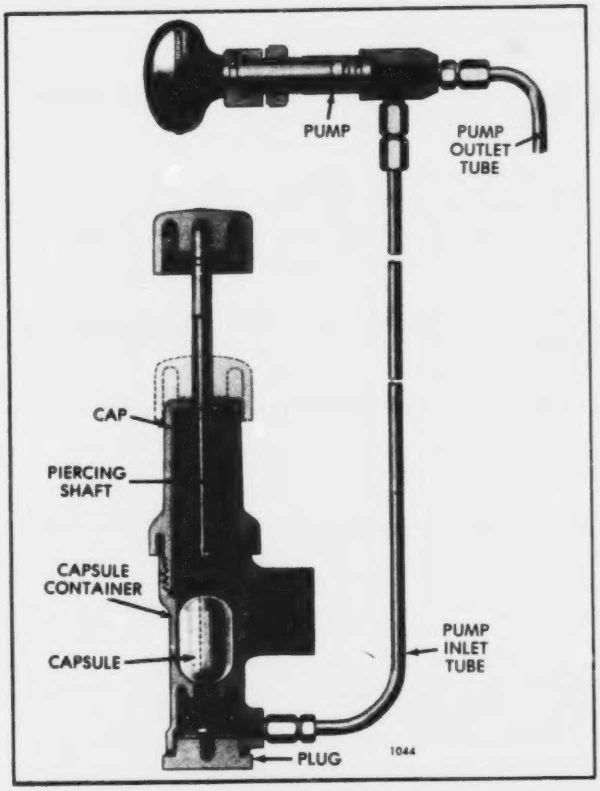


Fig. 11 - Typical Fluid Starting Aid

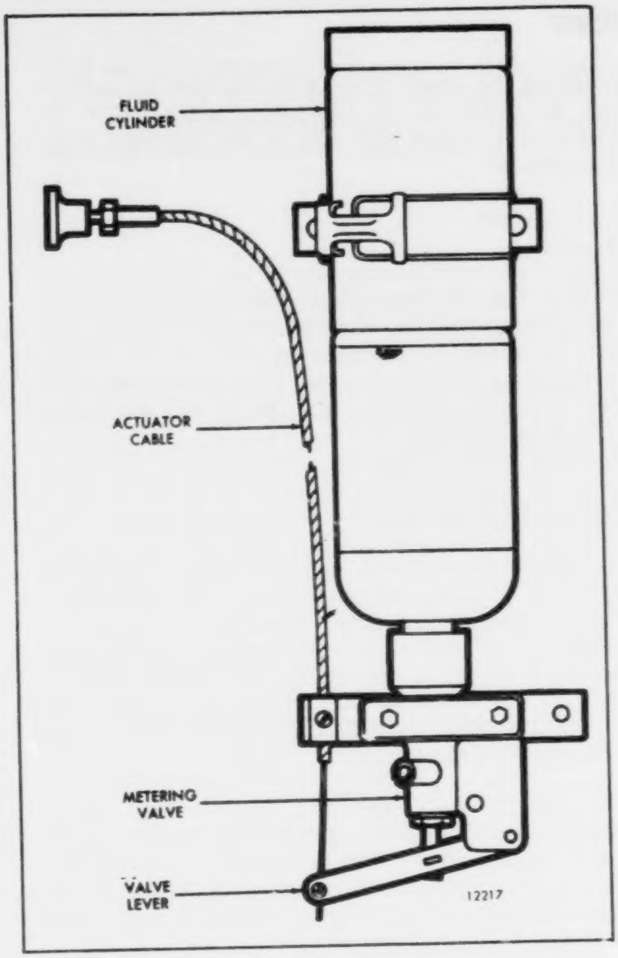


Fig. 12 - Quick Start Assembly

PRESSURIZED CYLINDER STARTING AID

Start the engine during cold weather, using the "Quick Start" starting aid system (Fig. 12) as follows:

1. Press the engine starter button.

2. Pull out the "Quick Start" knob for two seconds, then release it.

3. Repeat the procedure if the engine does not start on the first attempt.

> **CAUTION:** Do not crank the engine more than 30 seconds at a time when using an electric starting motor. Always allow one minute intervals between cranking attempts to allow the starting motor to cool.

Service

Periodically perform the following service items to assure good performance:

1. Remove the fluid cylinder and lubricate the valve around the pusher pin under the gasket with a few drops of oil.

2. Lubricate the actuator cable.

3. Actuate the valve with the cable to distribute the oil on the cable and allow the oil to run down through the valve.

4. Remove any dirt from the orifice by removing the air inlet housing fitting, the orifice block and the screen. Then blow air through the orifice end only.

5. Assemble and tighten the air inlet housing fitting to the actuator valve and tube.

6. Check for leakage of fluid (fogging) on the outside of the engine air inlet housing by actuating the starting aid while the engine is stopped. If fogging occurs, disassemble and retighten the air inlet housing fitting to the housing.

> **CAUTION:** Do not actuate the starting aid more than once with the engine stopped. *Overloading the engine air box with this high volatile fluid could result in a minor explosion.*

7. Check the fluid cylinder for hand tightness.

GOVERNORS

Engine Governors

Horsepower requirements of an engine may vary continually due to the fluctuating loads; therefore, a means must be provided to control the amount of fuel required to hold the engine speed reasonably constant during such load fluctuations. To accomplish this control, one of three types of governors is used on the engine, depending upon the application. Installations requiring maximum and minimum speed control, together with manually controlled intermediate speeds, ordinarily use a limiting speed mechanical governor. Applications requiring a near constant engine speed, under varying load conditions that may be changed by the operator, are equipped with a variable speed mechanical governor. The hydraulic governor is used where a uniform engine speed is required, under varying load conditions, with a minimum speed droop.

Lubrication

Mechanical governors are lubricated by oil that is sprayed from an orifice in the front blower end plate. This orifice directs a stream of oil into the revolving governor weights. The weights throw the oil to all moving parts within the governor.

Surplus oil returns to the engine crankcase through connecting passages in the blower and cylinder block.

When an engine equipped with a hydraulic governor is running, oil is supplied under pressure from the engine to the governor and a portion of the oil flows past the power piston and pilot valve plunger to lubricate the moving parts in the governor housing.

Oil which collects on the floor of the governor housing drains into the drive housing, thus providing lubrication for the drive and driven shafts and their bearings. If the engine should fail to supply oil to the governor, the power piston will drop allowing the fuel rod to return to the no-fuel position; thus the hydraulic governor also acts as an automatic shut-down device.

Service

Fluctuations of the engine speed usually indicates governor malfunction. However, these fluctuations can also be caused by an excessive load on the engine, misfiring, or binding linkage. Contact an authorized *Detroit Diesel Allison Service Outlet* for information regarding governors.

Output Shaft Governors

On certain applications equipped with a Torqmatic converter, it is sometimes desirable to maintain a constant output shaft speed regardless of the engine speed or load fluctuations. To acquire the necessary results, a governor driven by the output shaft is installed in conjunction with an engine governor. This governor is called an output shaft governor and may be mechanical or hydraulic.

The output shaft governor controls the engine governor (usually a limiting speed type) in the engine speed range between idle and maximum speed. The engine speed is prevented from going below idle or exceeding the maximum speed setting by the engine governor.

Service

Refer to the *Engine Tune-Up Procedures* for any adjustments to the output shaft governors or contact an authorized *Detroit Diesel Allison Service Outlet* for information regarding output shaft governors.

TRANSMISSIONS

This manual includes information on the lubrication and preventive maintenance of the transmissions. It also includes adjustment procedures covering some of the more common power transmissions.

Problems relating to the repair and overhaul of these transmissions should be referred to an authorized *Detroit Diesel Allison Service Outlet*.

POWER TAKE-OFF ASSEMBLIES

The front and rear power take-off units are basically similar in design, varying in clutch size to meet the requirements of a particular engine application.

The power take-off unit is attached to either an adaptor (front power take-off) or the engine flywheel housing (rear power take-off). Each power take-off unit has a single or double plate clutch. The drive shaft is driven by the clutch assembly and is supported by a pilot bearing in the flywheel or the adaptor and by two tapered roller bearings mounted in the clutch housing.

Clutch Adjustment

These instructions refer to field adjustment for clutch facing wear. Frequency of adjustment depends upon the amount and nature of the load.

To ensure a long clutch facing life and the best performance, the clutch should be adjusted before slippage occurs.

When the clutch is properly adjusted, a heavy pressure is required at the outer end of the hand lever to move the throwout linkage to the "over center" or locked position.

Adjust the 8", 11-1/2" and 14" diameter clutches as follows:

1. Disengage the clutch with the hand lever.

2. Remove the inspection hole cover to expose the clutch adjusting ring.

3. Rotate the clutch, if necessary, to bring the clutch adjusting ring lock within reach.

4. On the 8" and 11-1/2" diameter clutches, remove the clutch adjusting ring spring lock screw and lock from the inner clutch pressure plate and adjusting ring. Then, while holding the clutch drive shaft to prevent the clutch from turning, turn the clutch adjusting ring counterclockwise as shown in Fig. 13 and tighten the clutch until the desired pressure on the outer end of the hand lever, or at the clutch release shaft (Fig. 16), is obtained as shown in Table 1.

5. On the 14" diameter single and double plate clutches, raise the end of the adjusting ring lock up out of the splined groove in the hub of the outer clutch

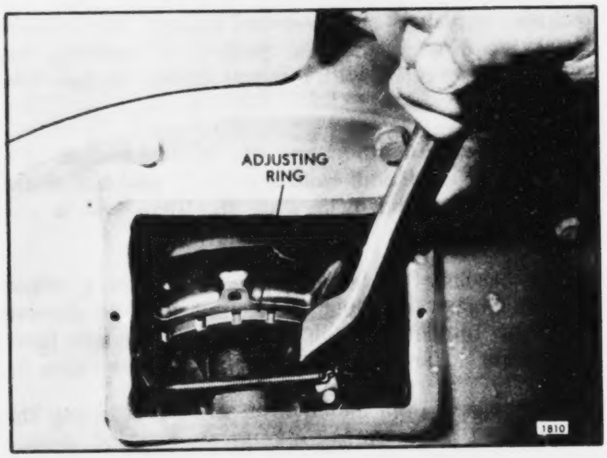


Fig. 13 - Power Take-Off Showing Typical 8 and 11-1/2 Inch Diameter Clutch Adjustment Ring

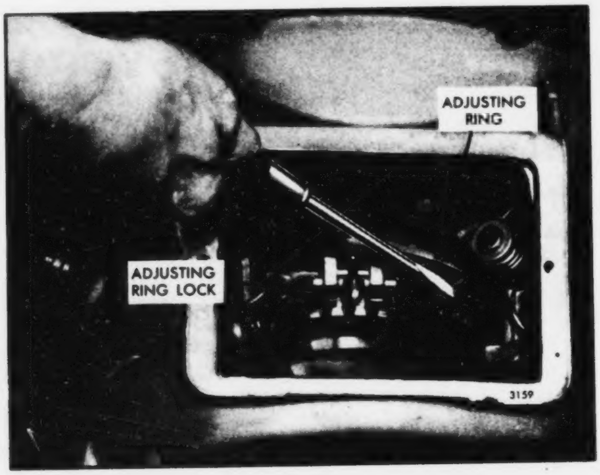


Fig. 14 - Power Take-Off Assembly Showing 14 Inch Diameter Clutch Adjustment Ring

pressure plate. Then, while holding the clutch drive shaft to prevent the clutch from turning, turn the clutch adjusting ring clockwise as shown in Fig. 14 and tighten the clutch until the desired pressure on the outer end of the hand lever, or at the clutch release shaft (Fig. 16), is obtained as shown in Table 1.

6. Install the clutch adjusting ring spring lock on the 8″ and 11-1/2″ diameter clutches. The ends of the lock must engage the notches in the adjusting ring. On the 14″ diameter clutch, reinstall the end of the adjusting ring lock in one of the splined grooves in the hub of the outer pressure plate. Then install the inspection hole cover.

Adjust the 18″ diameter clutch as follows:

1. Rotate the clutch, if necessary, to bring the adjustment lock and the pinion within reach through the inspection hole.

2. Loosen the lock bolt and pull the lock out of mesh with the adjusting ring; then, tighten the lock bolt to hold the lock out of the adjusting ring. While holding the clutch drive shaft to prevent the clutch from turning, turn the adjustment pinion clockwise to tighten the clutch as shown in Fig. 15.

3. Loosen the lock bolt and move the lock so it will mesh with the teeth of the adjusting ring, then tighten the lock bolt.

When properly adjusted, the approximate pressure required at the outer end of the hand lever to engage the various diameter clutches is shown in the table. These specifications apply only with the hand lever which is furnished with the power take-off.

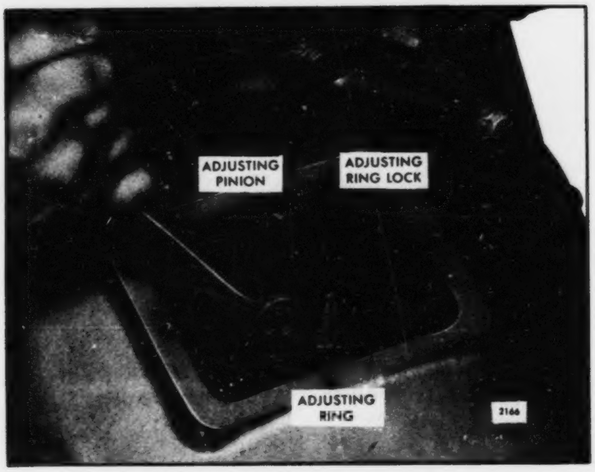


Fig. 15 - Power Take-Off Assembly Showing Method of Adjusting 18 Inch Diameter Clutch

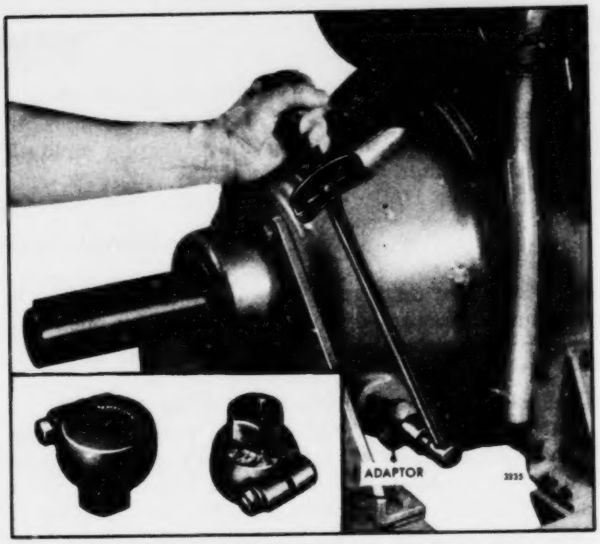


Fig. 16 - Checking Power Take-Off Clutch Adjustment with Torque Wrench and Adaptor

Clutch Dia.	Hand Lever Length	Pressure		Torque	
		psi	kPa	lb-ft	Nm
8″	20″	40	276	56-63	76-85
11-1/2″	20″	65	448	94-100	127-36
14″	25″	75	517	132-149	179-202
18″	40-3/8″	90	621	278-298	379-404

TABLE 1

A suitable spring scale may be used to check the pounds pressure required to engage the clutch. However, a more accurate method of checking the clutch adjustment is with a torque wrench as shown in Fig. 16.

To fabricate an adaptor, saw the serrated end off of a clutch hand lever and weld a 1-1/8″ nut (across the hex) on it as shown in Fig. 16. Then saw a slot through the nut.

When checking the clutch adjustment with a torque wrench, engage the clutch slowly and note the amount of torque immediately before the clutch engages (goes over center). The specified torque is shown in Table 1.

The facings of the clutch discs wear only along the area where they contact the pressure plates during engagement. The area on each side of the disc beyond the pressure plates does not wear proportionately, thus resulting in a ridge. This ridge on three segment clutches can complicate the job of making an adjustment inasmuch as the top segment tends to drop down when the engine is stopped. This drop lets the ridge locate between the pressure plates. The drive ring cannot be properly adjusted to the recommended engaging pressure with the disc so positioned. The condition can result in excessive slippage and a need for early clutch facing replacement.

Make a final clutch adjustment check with the engine running, to make sure the adjustment was not made against the ridge. The procedure is outlined below:

1. Start the engine and operate it at idling speed (approximately 500 rpm) with the clutch disengaged. The speed will be sufficient to move the segments out to operating position.

2. Check the pounds pressure required to engage the clutch. The engagement pressure should be the same as that following the adjustment. If the clutch engages at a lower pressure, the adjustment was probably made against the unworn portion of the facing.

3. Stop the engine and readjust the clutch, making sure all disc segments are properly positioned. Install the inspection hole cover.

TORQMATIC MARINE GEAR

The Torqmatic marine gear is used on 6V and 8V single engine marine units and tandem twin marine units. The marine gear consists of a reverse gear section and a reduction gear section. Each marine gear is available in several gear ratios.

The oil for operating the hydraulic clutches and for lubricating the reverse gear is contained in the reverse gear sump and is circulated throughout the system by a hydraulic oil pump mounted on the flywheel housing and driven from the blower drive shaft through a flexible coupling.

The oil pressure ranges for the marine gear at forward operating speed are 130-155 psi (896-1068 kPa) and 110-150 psi (758-1034 kPa) in reverse. The average operating oil temperature is 200 °F (93 °C) in forward and a maximum of 250 °F (121 °C) in reverse.

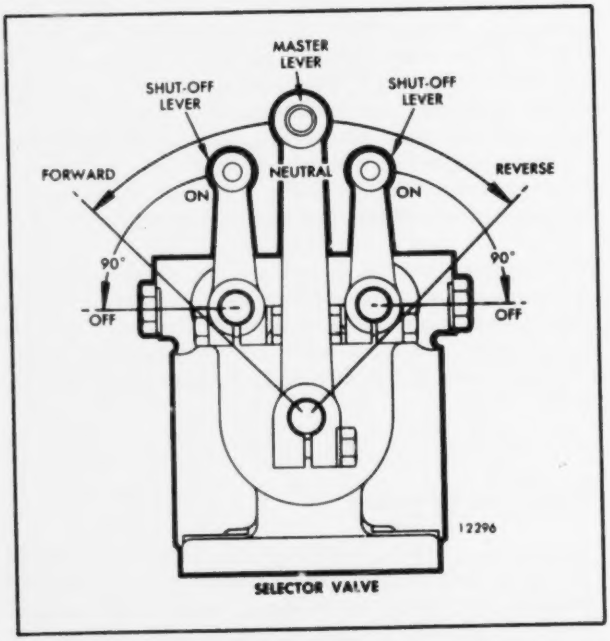


Fig. 17 - Lever Arrangement on Tandem Twin Engine Marine Gear Selector Valve

A strainer is used between the oil sump and the pump to remove harmful solids. The oil passes from the pump through a cooler to the control valve. From the control valve, the oil operates the forward or reverse clutch pistons and sprays oil into the reduction gear housing to lubricate the gear.

The constant flow control valve, incorporated with a pressure relief valve, controls the amount of oil pumped through the hydraulic system and is sensitive only to engine speed and operates independently of the pressure relief valve section which controls the pressure within the complete hydraulic system.

When the engine is in operation, the moving parts of the marine reverse gear are pressure lubricated while the reduction gear assembly is splash lubricated.

Shifting from forward to reverse drive through neutral may be made at any speed; however, it is advisable to shift at low engine speeds. For longest clutch life, reduce the engine speed to idle, make the shift and then increase the engine speed.

The marine gear selector control valve assembly on the tandem twin marine engine unit is provided with several levers (Fig. 17). The master control lever engages both marine gears in forward or reverse simultaneously. The smaller levers, one for each engine, operate the shut-off control valves for controlling the flow of oil to each individual engine marine gear. These levers are normally set in a vertical position ("on" position). To shutdown one engine for service work or to conserve on power in a light load situation, place the master control lever in the neutral position and then turn the shut-off lever for that engine to the "off" position (90 degrees toward the engine). With the shut-off lever in the "off" position, the marine gear for that engine is locked out of engagement. The other engine can then continue to supply power to the gear box.

> **CAUTION:** When the shut-off lever is turned to the **off** position, lock it in that position by wire or some other means to prevent vibration from moving it back up to the **on** position. This caution applies particularly when work is being done on the engine.

It is recommended that all sailing vessels and boats utilizing the Torqmatic marine gears (single or twin screw installations) have a locking (brake) device to prevent the propeller shaft from rotating while the sailing vessel is operating under sail, or the boat is operating with one engine shut down or being towed.

With the engine shut down, and the marine gear oil pump not operating, it cannot circulate lubricating oil through the reverse gear. Therefore, overheating and damage to the marine gear is possible unless rotation of the propeller shaft is prevented.

If the clutches cannot be engaged hydraulically, in an emergency, the forward drive may be engaged with three bolts as follows:

1. Remove the large pipe plug from the forward face of the flywheel housing.

2. With the throttle in the **stop** position, rotate the flywheel until one of the bolts aligns with the opening in the flywheel housing.

3. Remove the bolt from the flywheel.

4. Remove and save the jam nut, and replace the bolt finger-tight.

5. Remove and reinstall the remaining two bolts in the same manner.

6. Start at the first bolt and tighten all three bolts uniformly, thereby locking the clutch plate between the piston and the drive plate. Install the pipe plug in the flywheel housing.

> **NOTE:** To prevent binding between the piston and the bore in the flywheel, the emergency engagement bolts must be tightened uniformly.

> **CAUTION:** To prevent damaging the gear, do not use the reverse drive when the engagement bolts are engaged.

> **IMPORTANT:** To reduce the possibility of overheating, add an additional gallon of oil if the forward clutch is engaged with the emergency engagement bolts and the hydraulic pump is inoperative.

TWIN DISC MARINE GEAR

A Twin Disc marine gear is used on certain V-71 marine engines. This marine gear has two hydraulically operated multi-disc clutches to provide forward and reverse operation.

The marine gear has an oil sump capacity of approximately six gallons (22.71 litres). An oil pump driven by the reverse shaft operates whenever the engine is operating. This pump draws oil from the sump through a suction strainer, protecting the pump from foreign particles in the oil. The oil discharged from the pump flows through an oil cooler, mounted on the side of the engine, and then returns to the marine gear housing. The oil upon entering the gear housing passes through an integral oil filter and then to the selector valve. A by-pass valve across the filter prevents the stoppage of oil flow to the selector valve in the event the filter becomes clogged.

Some units incorporate a trolling valve which is mounted between the selector valve and the forward clutch. This valve is a relief valve with manual control over the relief valve spring. Movement of the trolling valve by the operator drops the forward clutch operating pressure to a point where the multi-disc clutch plates slip. Further movement of the valve increases the slippage. This permits very low propeller speeds necessary for some fishing operations. The entire oil spill from the trolling valve, in dropping the pressure, is directed through the plates of the forward slipping clutch. This provides a film of oil on which the plates ride and removes any heat generated.

The marine gear is driven by the engine through synthetic rubber caps molded in a gear tooth form. The rubber caps are mounted on the teeth of the spider gear and mesh with the flywheel drive ring. They cushion the drive from the engine to the marine gear.

Emergency Operation

In case of emergency shifting from forward to reverse at higher than normal engine speeds, the selector and pressure regulating valve should have a 1/2 second pause in neutral so that it can control the rate of pressure rise. This causes 3/4 to 1 1/2 second delay before full pressure is applied to the selected clutch. Thus, sudden shock on the gears and shafts is reduced. Complete reversal of the propeller is recommended only at reduced engine speeds.

Emergency Engagement

Should a failure impair the hydraulic system of the marine gear, the desired clutch, either forward or reverse, can be engaged manually. The manual engagement is accomplished by removing three pipe plugs, protruding from the rear of the transmission, in line with the desired clutch to be engaged. Then bar the engine output shaft over until the three emergency engagement bolts are in line with the holes. Alternately tighten the three bolts uniformly until the clutch is locked in engagement. Reinstall the pipe plugs.

The engine, when started with the selector valve in neutral, will drive the propeller through the engaged clutch. No attempt should be made to move the selector valve from the neutral position since engagement of the other clutch may cause damage.

TORQMATIC CONVERTERS

The Torqmatic converter is a self contained unit which transfers and multiplies the torque of the prime mover. This unit transmits the power through the action of oil instead of through gears and in addition to multiplying the torque also acts as a fluid coupling between the engine and the equipment to be powered. The converter will automatically adjust the output torque to load requirements.

There are various combinations of Torqmatic converters with features such as: an automotive or industrial flange on the shaft, a hydraulically operated lock-up clutch, a manual input disconnect clutch, and an accessory drive for either a governor or tachometer.

Check the oil level daily and, if the converter is equipped with an input disconnect clutch, additional checks and service will be necessary daily or at intervals determined by the type of operation.

Adjust the disconnect clutches as outlined under power take-off clutch adjustment.

Contact an authorized *Detroit Diesel Allison Service Outlet* for information on Torqmatic converters.

OPERATING INSTRUCTIONS

ENGINE OPERATING INSTRUCTIONS

PREPARATION FOR STARTING ENGINE FIRST TIME

Before starting an engine for the first time, carefully read and follow the instructions listed below and in the *Engine Tune-Up Procedure.* Attempting to run the engine before studying these instructions may result in serious damage to the engine.

> **NOTE:** When preparing to start a new or overhauled engine or an engine which has been in storage, perform all of the operations listed below. Before a routine start (at each shift), see *Daily Operations* in the *Lubrication and Preventive Maintenance Chart.*

Cooling System

Install all of the drain cocks or plugs in the cooling system (drain cocks are removed for shipping).

Open the cooling system vents, if the engine is so equipped.

Loosen the water return line near the top of the turbocharger (if used).

Remove the filler cap and fill the cooling system with clean, soft water or a protective solution consisting of high boiling point type antifreeze, if the engine will be exposed to freezing temperatures (refer to *Engine Coolant*). Keep the liquid level about two inches below the filler neck to allow for fluid expansion.

Use a quality rust inhibitor if only water is used in the cooling system.

Close the vents, if used, after filling the cooling system.

Tighten the turbocharger water return line.

On marine installations, prime the raw water cooling system and open any sea cocks in the raw water pump intake line. Prime the raw water pump by removing the pipe plug or electrode provided in the pump outlet elbow and pour water in the pump.

> **CAUTION:** Failure to prime the raw water pump may result in damage to the pump impeller.

Lubrication System

The lubricating oil film on the rotating parts and bearings of a new or overhauled engine, or one which has been in storage, may be insufficient for proper lubrication when the engine is started for the first time.

It is recommended that the engine lubricating system be charged with a pressure prelubricator, set to supply a minimum of 25 psi (172 kPa) oil pressure, to ensure an immediate flow of oil to all bearings at the initial engine start-up. The oil supply line should be attached to the engine so that oil under pressure is supplied to the main oil gallery.

With the oil pan dry, use the prelubricator to prime the engine with sufficient oil to reach all bearing surfaces. Use *heavy-duty* lubricating oil as specified under *Lubricating Oil Specifications.* Then remove the dipstick, wipe it with a clean cloth, insert and remove it again to check the oil level in the oil pan. Add sufficient oil, if necessary, to bring it to the full mark on the dipstick. Do not overfill.

If a pressure prelubricator is not available, fill the crankcase to the proper level with *heavy-duty* lubricating oil as specified under *Lubricating Oil Specifications.* Then pre-lubricate the upper engine parts by removing the valve rocker covers and pouring lubricating oil, of the same grade and viscosity as used in the crankcase, over the rocker arms.

Turbocharger

Disconnect the turbocharger oil inlet line and pour approximately one pint of clean engine oil in the line, thus making sure the bearings are lubricated for the initial start. Reconnect the oil line.

Air Cleaner

If the engine is equipped with oil bath air cleaners, fill the air cleaner oil cups to the proper level with clean engine oil. *Do not overfill.*

Transmission

Fill the transmission case, marine gear or torque converter supply tank to the proper level with the lubricant specified under *Lubrication and Preventive Maintenance*.

Fuel System

Fill the fuel tank with the fuel specified under *Diesel Fuel Oil Specifications*.

If the unit is equipped with a fuel valve, it must be opened.

To ensure prompt starting, fill the fuel system between the pump and the fuel return manifold with fuel. If the engine has been out of service for a considerable length of time, prime the filter between the fuel pump and the injectors. The filter may be primed by removing the plug in the top of the filter cover and slowly filling the filter with fuel.

In addition to the above, on an engine equipped with a hydrostarter, use a priming pump to make sure the fuel lines and the injectors are full of fuel before attempting to start the engine.

> **NOTE:** The fuel system is filled with fuel before leaving the factory. If the fuel is still in the system when preparing to start the engine, priming should be unnecessary.

Engine Out of Fuel

The problem in restarting the engine after it has run out of fuel stems from the fact that after the fuel is exhausted from the fuel tank, fuel is then pumped from the primary fuel strainer and sometimes partially removed from the secondary fuel filter before the fuel supply becomes insufficient to sustain engine firing. Consequently, these components must be refilled with fuel and the fuel pipes rid of air in order for the system to provide adequate fuel for the injectors.

When an engine has run out of fuel, there is a definite procedure to follow for restarting the engine.

1. Fill the fuel tank with the recommended grade of fuel oil. If only partial filling of the tank is possible, add a minimum of ten gallons (38 litres) of fuel.

2. Remove the fuel strainer shell and element from the strainer cover and fill the shell with fuel oil. Install the shell and element.

3. Remove and fill the fuel filter shell and element with fuel oil as in Step 2.

4. Start the engine. Check the filter and strainer for leaks.

> **NOTE:** In some instances, it may be necessary to remove a valve rocker cover and loosen a fuel pipe nut in order to bleed trapped air from the fuel system. Be sure the fuel pipe is retightened securely before replacing the rocker cover.

Primer J 5956 may be used to prime the entire fuel system. Remove the filler plug in the fuel filter cover and install the primer. Prime the system. Remove the primer and install the filler plug.

Lubrication Fittings

Fill all grease cups and lubricate at all fittings with an all purpose grease. Apply lubricating oil to the throttle linkage and other moving parts and fill the hinged cap oilers with a hand oiler.

Drive Belts

Adjust all drive belts as recommended under *Lubrication and Preventive Maintenance*.

Storage Battery

Check the battery. The top should be clean and dry, the terminals tight and protected with a coat of petroleum jelly and the electrolyte must be at the proper level.

> **NOTE:** When necessary, check the battery with a hydrometer; the reading should be 1.265 or higher. However, hydrometer readings should always be corrected for the temperature of the electrolyte.

Generator Set

Where applicable, fill the generator end bearing housing with the same lubricating oil as used in the engine.

A generator set should be connected and grounded in accordance with the applicable local electrical codes.

CAUTION: The base of a generator set must be grounded.

Clutch

Disengage the clutch, if the unit is so equipped.

STARTING

Before starting the engine for the first time, perform the operations listed under *Preparation For Starting Engine First Time.*

Before a routine start, see *Daily Operations* in the *Lubrication and Preventive Maintenance Chart.*

If a manual or an automatic shutdown system is incorporated in the unit, the control must be set in the open position before starting the engine. The blower will be seriously damaged if operated with the air shut-off valve in the closed position.

NOTE: On engines with dual air shutdown housings, both air shut-off valves must be in the open position before starting the engine.

Starting at air temperatures below 40°F (4°C) requires the use of a cold weather starting aid. See *Cold Weather Starting.*

The instructions for the use of a cold weather fluid starting aid will vary dependent on the type being used. Reference should be made to these instructions before attempting a cold weather start.

WARNING: Starting fluid used in capsules is highly inflammable, toxic and possesses anesthetic properties.

Initial Engine Start (Electric)

Start an engine equipped with an electric starting motor as follows: Set the speed control lever at part throttle, then bring it back to the desired no-load speed. In addition, on mechanical governors, make sure the stop lever on the governor cover is in the *run* position; on hydraulic governors, make sure the stop knob is pushed all the way in. Then press the starting motor switch firmly. If the engine fails to start within 30 seconds, release the starting switch and allow the starting motor to cool a few minutes before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

CAUTION: To prevent serious damage to the starter, if the engine does not start, do not press the starting switch again while the starting motor is running.

Initial Engine Start (Hydrostarter)

Start an engine equipped with a hydrostarter as follows:

Use the priming pump to make sure the fuel filter, fuel lines and injectors are full of fuel before attempting to start the engine.

Raise the hydrostarter accumulator pressure with the hand pump until the gage reads as indicated in Table 1.

Set the engine controls for starting with the throttle at least half open.

NOTE: During cold weather, add starting fluid at the same time the hydrostarter motor lever is moved. Do not wait to add the fluid after the engine is turning over

Push the hydrostarter control lever to simultaneously engage the starter pinion with the flywheel ring gear and to open the control valve. Close the valve as soon as the engine starts to conserve the accumulator pressure and to avoid excessive over-running of the starter drive clutch assembly.

Ambient Temperature	Pressure	
	psi	kPa
Above 40° F (4° C)	1500	10 335
40° -0° F (4° to −18° C)	2500	17 225
Below 0° F (−18° C)	3300	27 737

TABLE 1

RUNNING

Oil Pressure

Observe the oil pressure gage immediately after starting the engine. If there is no pressure indicated within 10 to 15 seconds, stop the engine and check the lubricating oil system. The pressure should not fall below 25 psi (172 kPa) at 1200 rpm or 30 psi (207 kPa) at 2100 rpm and normal operating pressure should be higher.

Warm- Up

Run the engine at part throttle and no-load for approximately five minutes, allowing it to warm-up before applying a load.

If the unit is operating in a closed room, start the room ventilating fan or open the windows, as weather conditions permit, so ample air is available for the engine.

Inspection

While the engine is running at operating temperature, check for coolant, fuel or lubricating oil leaks. Tighten the line connections where necessary to stop leaks.

Engine Temperature

Normal engine coolant temperature is 160-185° F (71-85° C).

Crankcase

If the engine crankcase was refilled, stop the engine after normal operating temperature has been reached, allow the oil to drain (approximately 20 minutes) back into the crankcase and check the oil level. Add oil, if necessary, to bring it to the proper level on the dipstick.

Use only the *heavy duty* lubricating oil specified under *Lubricating Oil Specifications.*

Clutch

Do not engage the clutch (with a sintered iron clutch plate) at engine speeds over 850 rpm. A clutch with an asbestos or vegetable fiber material clutch plate must not be engaged at speeds over 1000 rpm.

Operating Oil Pressure at 180° F (82° C)*

Marine Gear	Position	† Test rpm	Test Pressure	
			psi	kPa
MG-506 (except 1.5:1 and 2:1 ratios)	Neutral and Engaged	600	280-315	1930-2170
	Neutral and Engaged	1800	300-320	2067-2205
	Cruising	Min.	270	1861
MG-506 (only 1.5:1 and 2:1 ratios)	Neutral and Engaged	600	330-365	2274-2515
	Neutral and Engaged	1800	350-370	2412-2550
	Cruising	Min.	335	2308
MG-509	Neutral	600	35-70	241-483
	Neutral	1800	50-85	345-586
	Engaged	600	187-215	1289-1481
	Engaged	1800	193-220	1330-1516
	Cruising	Min.	165	1137
MG-512	Neutral	600	45-70	310-483
	Neutral	1800	60-90	414-621
	Engaged	600	185-215	1275-1481
	Engaged	1800	195-220	1344-1516
	Cruising	Min.	185	1275
MG-513	Neutral	600	70-110	483-758
	Neutral	1800	90-130	621-896
	Engaged	600	230-270	1585-1861
	Engaged	1800	240-280	1654-1930
	Cruising	Min.	234	1612
MG-514 (less than 4:1 ratio) (shallow case)	Neutral	600	20-65	138-448
	Neutral	1800	45-92	310-634
	Engaged	600	210-235	1447-1619
	Engaged	1800	228-237	1571-1633
	Cruising	Min.	215	1481
MG-514 (4:1 and greater ratio) (deep case)	Neutral	600	35-65	241-448
	Neutral	1800	50-85	379-586
	Engaged	600	187-215	1289-1481
	Engaged	1800	193-220	1330-1516
	Cruising	Min.	185	1275
MG-521	Neutral	600	45-85	310-586
	Neutral	1800	75-100	517-689
	Engaged	600	180-215	1241-1481
	Engaged	1800	188-220	1296-1516
	Cruising	Min.	165	1137
MG-527	Neutral	600	45-85	310-586
	Neutral	1800	65-100	448-689
	Engaged	600	180-215	1241-1481
	Engaged	1800	188-220	1296-1516
	Cruising	Min.	165	1137

* Sump or heat exchanger inlet 210° F (99° C) maximum. Normal operating range desired 140-180° F (60-82° C) minimum continuous duty.

† Sump or heat exchanger inlet 225° F (107° C) maximum intermittent permissable in pleasure craft.

TABLE 2—Twin Disc Marine Gear Operating Conditions

Cooling System

Remove the radiator or heat exchanger tank cap *slowly* after the engine has reached normal operating temperature and check the engine coolant level. The coolant level should be near the top of the opening. If necessary, add clean soft water or a high boiling point type antifreeze.

Transmission

Check the marine gear oil pressure. The operating oil pressure range at operating speed is 130-155 psi (896-1068 kPa) (Allison Torqmatic gear). The operating oil pressure varies with the different Twin Disc gears as noted in Table 2. Check and, if necessary, replenish the oil supply in the transmission.

Turbocharger

Make a visual inspection of the turbocharger for leaks and excessive vibration. Stop the engine immediately if there is an unusual noise in the turbocharger.

Avoid Unnecessary Engine Idling

During long engine idling periods, the engine coolant temperature will fall below the normal operating range. The incomplete combustion of fuel in a cold engine will cause crankcase dilution, formation of lacquer or gummy deposits on the valves, pistons and rings and rapid accumulation of sludge in the engine.

> **NOTE:** When prolonged engine idling is necessary, maintain at least 800 rpm.

STOPPING

Normal Stopping

1. Release the load and decrease the engine speed. Put all shift levers in the *neutral* position.

2. Allow the engine to run at half speed or slower with no load for four or five minutes, then move the stop lever to the *stop* position to shut down the engine.

Emergency Stopping

If the engine does not stop after using the normal stopping procedure, pull the "Emergency Stop" knob all the way out. This control cuts off the air to the engine. Do not try to restart again until the cause for the malfunction has been found and corrected.

> **CAUTION:** The emergency shutdown system should never be used except in an emergency. Use of the emergency shutdown can cause oil to be sucked past the oil seals and into the blower housing.

The air shut-off valve, located on the blower air inlet housing, must be reset by hand and the "Emergency Stop" knob pushed in before the engine is ready to start again.

Fuel System

If the unit is equipped with a fuel valve, close it. Fill the fuel tank; a full tank minimizes condensation.

Exhaust System

Drain the condensation from the exhaust line or silencer.

Cooling System

Drain the cooling system if it is not protected with antifreeze and freezing temperatures are expected. Leave the drains open. Open the raw water drains of a heat exchanger cooling system.

Crankcase

Check the oil level in the crankcase. Add oil, if necessary, to bring it to the proper level on the dipsticks.

Transmission

Check and, if necessary, replenish the oil supply in the transmission.

Clean Engine

Clean and check the engine thoroughly to make certain it will be ready for the next run.

Refer to *Lubrication and Preventive Maintenance* and perform all of the daily maintenance operations. Also perform the operations required for the number of hours or miles the engine has been in operation.

Make the necessary adjustments and minor repairs to correct difficulties which became apparent to the operator during the last run.

ALTERNATING CURRENT POWER GENERATOR SET OPERATING INSTRUCTIONS

These instructions cover the fundamental procedures for operating an alternating current power generator set. The operator should read these instructions before attempting to operate the generator set.

PREPARATION FOR STARTING

Before attempting to start a new or an overhauled engine or an engine which has been in storage, perform all of the operations listed under *Preparation for Starting Engine First Time*. Before a routine start see *Daily Operations* in the *Lubrication and Preventive Maintenance Chart*.

In addition to the *Engine Operating Instructions*, the following instructions also apply when operating an alternating current power generator set.

1. Before the first start, check the generator main bearing oil reservoir. If necessary, add sufficient lubricating oil of the same grade that is used in the engine crankcase to bring it to the proper level on the sight gage. *Do not overfill.*

2. Check the interior of the generator for dust or moisture. Blow out dust with low pressure air (25 psi or 172 kPa maximum). If there is moisture on the interior of the generator, it must be dried before the set is started. Refer to the appropriate Delco Products Maintenance Bulletin.

3. The overspeed trip solenoid lever located at the air inlet housing must be in the open or reset position.

4. Refer to Fig. 1 and place the circuit breaker (10) in the *off* position.

5. Place the field switch (7) in the *off* position.

6. Place the synchronizing lamp switch (6) in the *off* position.

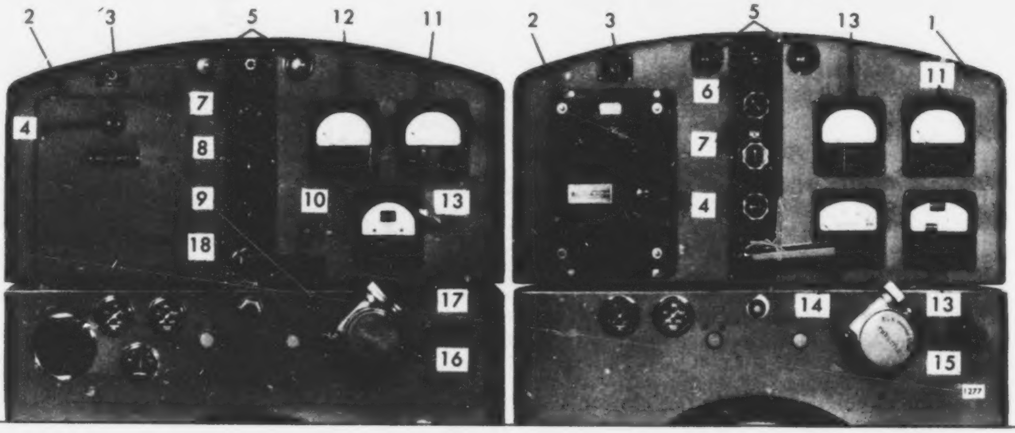
7. Place the voltage regulator switch (3) in the *off* or *manual* position.

8. Turn the field rheostat knob (8) clockwise to its lower limits.

9. Make sure the power generator set has been cleared of all tools or other objects which might interfere with its operation.

STARTING

If the generator set is operated in a closed space, start the ventilating fan or open the doors and windows, as weather permits, to supply ample air to the engine.



1. Cabinet--Control
2. Regulator--Voltage
3. Switch--Voltage Regulator
4. Control--Voltage Regulator Rheostat
5. Lamps--Synchronizing
6. Switch--Synchronizing Lamp
7. Switch--Field
8. Control--Manual Field Rheostat
9. Switch--Selector
10. Control--Circuit Breaker
11. Ammeter
12. Voltmeter
13. Frequency Meter
14. Kilowatt Meter
15. Button--Throttle
16. Control--Throttle
17. Knob--Vernier Throttle
18. Button--Engine Starter

Fig. 1 – Typical Alternating Current Generator Control Cabinets

The engine may require the use of a cold weather starting aid if the ambient temperature is below 40° F (4° C). Refer to *Cold Weather Starting Aids*.

Press the throttle button (15) and turn the throttle control (16), Fig. 1, counterclockwise to a position midway between *run* and *stop*. Then press the starter button (18) firmly.

If the engine fails to start within 30 seconds, release the starter button and allow the starting motor to cool a few minutes before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

> **CAUTION:** To prevent serious damage to the starter if the engine does not start, do not press the starter switch again while the starter motor is rotating.

RUNNING

If the oil pressure is observed to be normal, increase the throttle setting to cause the engine to run at its synchronous speed.

PREPARING GENERATOR FOR LOAD

After the engine has warmed up (or the oil pressure has stabilized), prepare the generator set for load as follows:

1. Bring the engine up to rated speed. Then place the field switch (7), Fig. 1, in the *on* position.

2. Turn the voltage regulator switch (3) *on*.

3. Turn the instrument selector switch (9) to the desired position.

4. Turn the field rheostat (8) slowly in a counterclockwise direction to raise the voltage, while watching the voltmeter, until the rheostat reaches the end of its travel. The voltage regulator will take control of the generator voltage as the field rheostat reaches the end of its travel.

5. If the power generator unit is equipped with a frequency meter, adjust the engine speed with the vernier throttle knob (17) until the desired frequency is indicated on the meter.

6. Adjust the voltage regulator rheostat (4) to obtain the desired voltage.

7. Make sure all power lines are clear of personnel, then place the circuit breaker control (10) in the *on* position.

> **NOTE:** Perform Step 7 only if the set is not being paralleled with an existing power source. If the set is being paralled with a power source already on the line, read and follow the instructions under *Paralleling* before turning the circuit breaker control to the *on* position.

PARALLELING

If the load conditions require an additional set to be placed on the line, the following instructions will apply to power generator sets of *equal capacity*, with one set in operation on the line.

1. Prepare the set to be paralleled as outlined under *Preparation for Starting, Starting, Running* and Items 1 through 6 under *Preparing Generator for Load*.

2. Check the voltmeter (12), Fig. 1; the voltage must be the same as the line voltage. Adjust the voltage regulator rheostat control (4) if the voltages are not the same.

3. Place the synchronizing lamp switch (6), of the generator set to be paralleled, in the *on* position.

4. Turn the vernier throttle knob (17) until both sets are operating at approximately the same frequency, indicated by the slow change in the brilliancy of the synchronizing lamps.

5. When the synchronizing lamps glow and then go out at a very slow rate, time the dark interval. Then, in the middle of this interval turn the circuit breaker control to the *on* position. This places the incoming set on the line, with no load. The proper share of the existing load must now be placed on this set.

6. The division of the kilowatt load between the alternating current generators operating in parallel depends on the power supplied by the engines to the generators as controlled by the engine governors and is practically independent of the generator excitation. Divide the kilowatt load between the sets by turning the vernier throttle knob (17) counterclockwise on the incoming set and clockwise on the set that has been carrying the load (to keep the frequency of the sets constant) until both kilowatt meters indicate that each set is carrying its proper percentage of the total K.W. load. Refer to Item 8 if the sets are not equipped with kilowatt meters.

7. The division of the reactive KVA load depends on the generator excitation as controlled by the voltage regulator. Divide the reactive load between the sets by turning the voltage regulator rheostat control on the incoming set (generally counterclockwise to raise the voltage) until the ammeters read the same on both sets and the sum of the readings is minimum.

> **NOTE:** The generator sets are equipped with a resistor and current transformer connected in series with the voltage coil of the regulator (cross-current compensation) which equalizes most but not all of the reactive KVA load between the generators.

8. When the load is unity power factor (lighting and a few small motors only), follow the instructions in Item 6 above until both ammeters read the same.

9. When the load is 80 per cent power factor lagging (motor and a few lights only), turn the vernier throttle knob (17) on the incoming set until the ammeter on that set reads approximately 40 per cent of the total current load.

10. Rotate the voltage regulator rheostat control (4) on the incoming set (generally counterclockwise to raise the voltage) until the ammeters read the same on both sets.

> **NOTE:** If a load was not added during paralleling, the total of the two ammeter readings should be the same as the reading before paralleling. Readjust the voltage regulator rheostat (4) on the incoming set, if necessary.

11. To reset the load voltage, turn the voltage regulator rheostat controls slowly on each set. It is necessary to turn the controls the same amount and in the same direction to keep the reactive current equally divided.

Power generator sets with different capacities can also be paralleled by dividing the load proportionately to their capacity.

STOPPING

The procedure for stopping a power generator set or taking a set out of parallel is as follows:

1. Turn off all the load on the generator when stopping a single engine unit. Shift the load from the generator when taking a set out of parallel operation by turning the vernier throttle knob (17), Fig. 1, until the ammeter (11) reads approximately zero.

2. Place the circuit breaker control (10) in the *off* position.

3. Turn the field rheostat (8) to the fully clockwise position.

4. Turn the voltage regulator switch (3) to the *off* position.

5. Place the field switch (7) in the *off* position.

6. Press the throttle button (15) and turn the throttle control (16) to *stop* to shut down the engine.

> **NOTE:** When performing a tune-up on a unit that will be operated in parallel with another set, adjust the speed droop as specified in *Engine Tune-Up*.

LUBRICATION AND PREVENTIVE MAINTENANCE

To obtain the long life and the best performance from a Detroit Diesel engine, the Operator must adhere to the following schedule and instructions on lubrication and preventive maintenance.

The daily instructions pertain to routine or daily starting of an engine and not to a new engine or one that has not been operated for a considerable period of time. For new or stored engines, carry out instructions given under *Preparation for Starting Engine First Time* under *Operating Instructions.*

The time intervals given in the chart on the following page are actual operating hours or miles of an engine. If the lubricating oil is drained immediately after an engine has been run for some time, most of the sediment will be in suspension and, therefore, will drain readily.

All authorized *Detroit Diesel Allison Service Outlets* are prepared to service engines with the viscosity and grade of lubricants recommended on the following pages.

LUBRICATION AND PREVENTIVE MAINTENANCE CHART	Time Interval								
Hours		8	50	100	200	300	500	1,000	2,000
Item Operation — Miles	Daily	240	1,500	3,000	6,000	9,000	15,000	30,000	60,000
1. Engine Oil	X								
2. Oil Filter*									
3. Coolant and Filter	X						X	X	
4. Hoses							X		
5. Radiator								X	
6. Heat Exchanger Electrodes and Core							X	X	
7. Raw Water Pump	X								
8. Fuel Tank	X						X		
9. Fuel Strainer and Filter	X					X			
10. Air Cleaners		X			X		X		
11. Air Box Drains								X	
12. Ventilating System								X	
13. Blower Screen								X	
14. Starting Motor*									
15. Battery-Charging Generator				X	X				
16. Battery				X					
17. Tachometer Drive				X					
18. Throttle and Clutch Controls					X				
19. Engine Tune-Up*									
20. Drive Belts		X			X				
21. Overspeed Governor							X		
22. Fan Hub Bearings*									
23. Shut-Down System						X			
24. Hydrostarter System*									
25. Air Compressor Air Strainer					X				
26. Turbocharger*									
27. Thermo-Modulated Fan*									
28. Power Generator				X		X			
29. Power Take-Off		X	X				X		
30. Torqmatic Converter	X		X					X	
31. Marine Gear	X				X †			X **	
32. Reduction Gear (Single Engine Units)		X	X				X	X	
33. Reduction Gear (Multiple Engine Units)	X				X				

*See items on following pages ** Twin Disc Marine Gear † Allison Torqmatic Marine Gear

Item 1

Check the oil level daily before starting the engine. Add oil, if necessary, to bring it to the proper level on the dipstick.

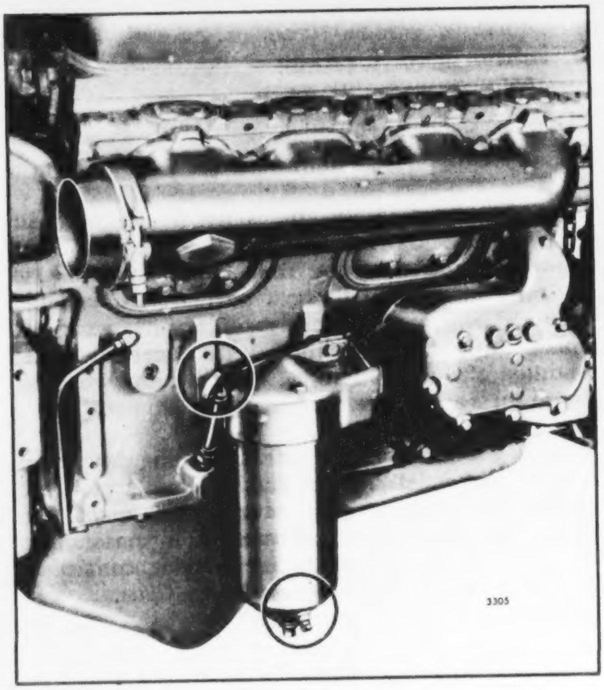
> **NOTE:** If the engine has just been stopped, wait approximately twenty minutes to allow the oil to drain back to the oil pan before checking the oil level.

Select the proper grade of oil in accordance with the instructions given in the *Lubricating Oil Specifications*.

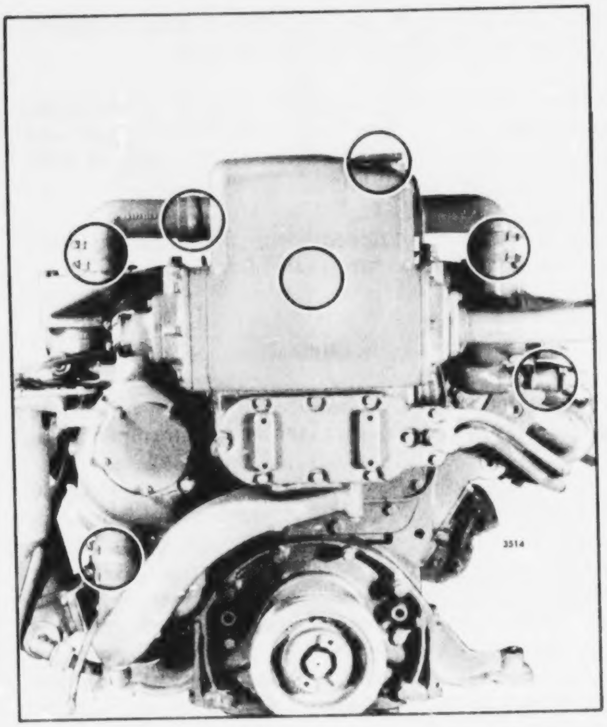
It is recommended that new engines be started with 100 hour oil change periods. The drain interval may then be gradually increased, or decreased, following the recommendations of an independent oil analysis laboratory or the oil supplier (based upon the oil sample analysis) until the most practical oil change period has been established.

Item 2

Change the engine oil filter elements and gaskets each time the engine oil is changed. Any deviation, such as changing filters every other oil change, should be based on a laboratory analysis of the drained oil and used filter elements to determine if such practice is practical for proper protection of the engine.

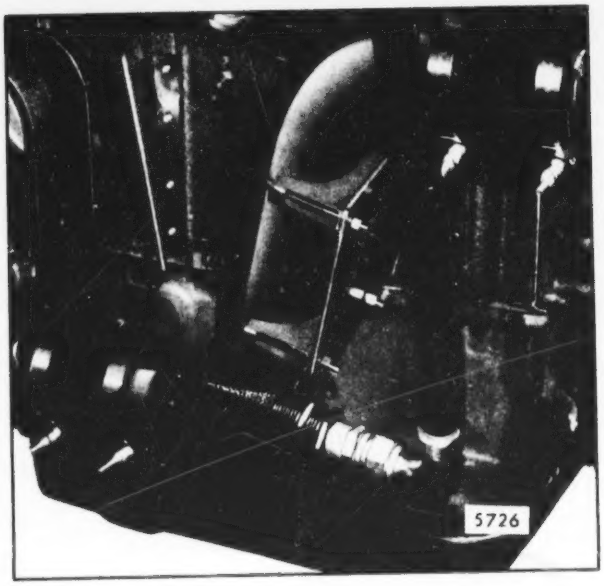


Items 1 and 2



Items 3 and 4

Make a visual check of all lubricating oil lines for



Item 3

wear and chafing. If any indication of wear is evident, replace the oil lines and correct the cause.

When the engine is equipped with a turbocharger, disconnect the oil inlet line at the turbocharger and pour approximately four ounces of oil in the oil inlet, then reconnect the oil line.

If the engine is equipped with a governor oil filter, change the element every 1,000 hours.

Item 3

Check the coolant level daily and maintain it near the top of the heat exchanger tank or radiator upper tank.

Clean the cooling system every 1,000 hours or 30,000 miles (48 280 km) using a good radiator cleaning compound in accordance with the instructions on the container. After the cleaning operation, rinse the cooling system thoroughly with fresh water. Then fill the system with soft water, adding a good grade of rust inhibitor or a high boiling point type antifreeze (refer to *Engine Coolant)*. With the use of a proper antifreeze or rust inhibitor, this interval may be lengthened until, normally, this cleaning is done only in the spring or fall. The length of this interval will, however, depend upon an inspection for rust or other deposits on the internal walls of the cooling system. When a thorough cleaning of the cooling system is required, it should be reverse flushed.

The coolant circulated through the intercoolers on a turbocharged intercooler engine is protected by a 20 mesh cone-shaped water filter (screen). The filter is located at the water connection in the water pump-to-engine oil cooler tube. The filter should be inspected for damage or clogging when the cooling system is cleaned. Disconnect the flexible water hose at the water connection and remove and clean the filter. If necessary, replace the filter. Reinstall the water filter (screen) in the water connection.

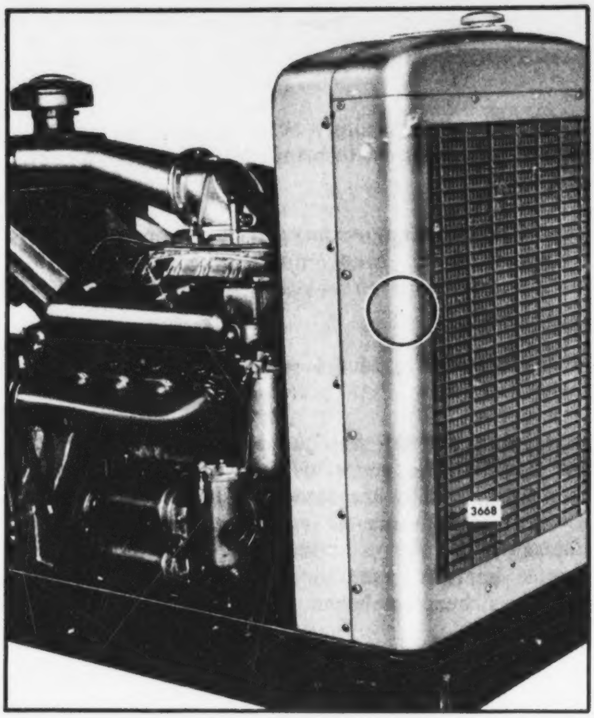
If the cooling system is protected by a coolant filter and conditioner, the filter element should be changed every 500 hours or 15,000 miles (24 140 km).

Item 4

Inspect all of the cooling system hoses at least once every 500 hours or 15,000 miles (24 140 km) for signs of deterioration. Replace the hoses if necessary.

Item 5

Inspect the exterior of the radiator core every 1,000 hours or 30,000 miles (48 280 km) and, if necessary, clean it with a quality grease solvent such as mineral spirits and dry it with compressed air. *Do not use fuel oil, kerosene or gasoline.* It may be necessary to clean the radiator more frequently if the engine is being operated in dusty or dirty areas.



Item 5

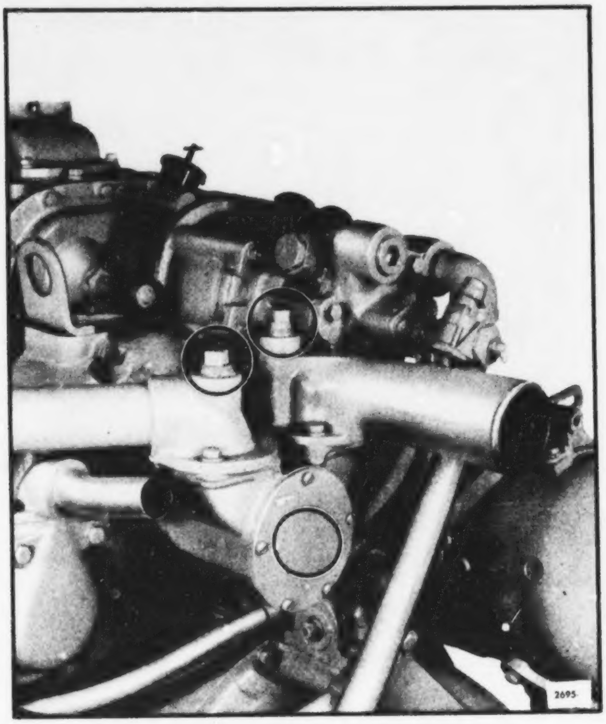
Item 6

Every 500 hours, drain the water from the heat exchanger raw water inlet and outlet tubes. Then remove the zinc electrodes from the inlet side of the raw water pump and the heat exchanger. Clean the electrodes with a wire brush or, if worn excessively, replace with new electrodes. To determine the condition of a used electrode, strike it sharply against a hard surface; a weakened electrode will break.

Drain the cooling system, disconnect the raw water pipes at the outlet side of the heat exchanger and remove the retaining cover every 1,000 hours and inspect the heat exchanger core. If a considerable amount of scale or deposits are present, contact an authorized *Detroit Diesel Allison Service Outlet.*

Item 7

Check the prime on the raw water pump; the engine

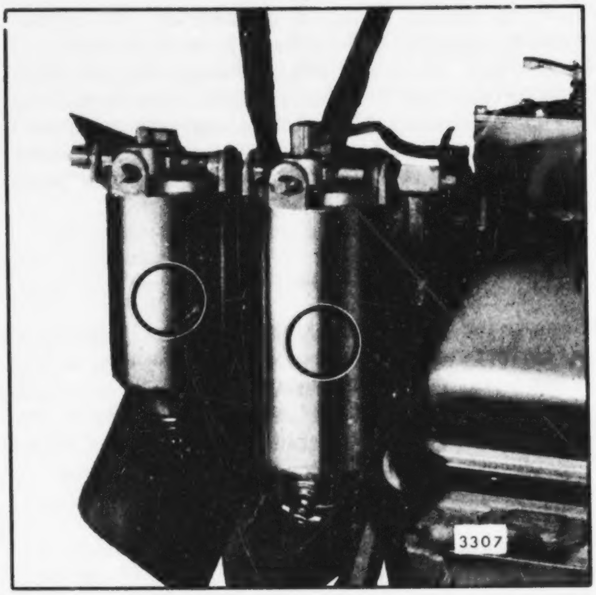


Items 6 and 7

should not be operated with a dry pump. Prime the pump, if necessary, by removing the pipe plug provided in the pump inlet elbow and adding water. Reinstall the plug.

Item 8

Keep the fuel tank filled to reduce condensation to a minimum. Select the proper grade of fuel in accordance with the *Diesel Fuel Oil Specifications*.



Item 9

Open the drain at the bottom of the fuel tank every 500 hours or 15,000 miles (24 140 km) to drain off any water or sediment.

Item 9

Install new elements every 300 hours or 9,000 miles (14 484 km) or when plugging is indicated.

A method of determining when elements are plugged to the extent that they should be changed is based on the fuel pressure at the cylinder head fuel inlet manifold and the inlet restriction at the fuel pump. In a clean system, the maximum pump inlet restriction

Fuel Pressure at Inlet Manifold										
Engine	Speed (rpm)									
	1200		1800		2000		2100		2300	
	psi	kPa	psi	kPa	psi	kPa	psi	kPa	psi	kPa
V-71, V-71N (6,8,12V) Normal	35-70	241-483	45-70	310-483			45-70	310-483		
8V-71T Normal			45-70	310-483	45-70	310-483			45-70	310-483
12V-71T Normal							45-60	310-414	45-60	310-414
16V-71 Normal	35-70	241-483	45-70	310-483			45-70	310-483		
16V-71N Normal	35-70	241-483	45-70	310-483			45-70	310-483		
16V-71T Except Standby Gen. Set			45-70	310-483	45-70	310-483	45-70	310-483		
16V-71T With Standby Gen. Set			50-70	345-483						

TABLE 1

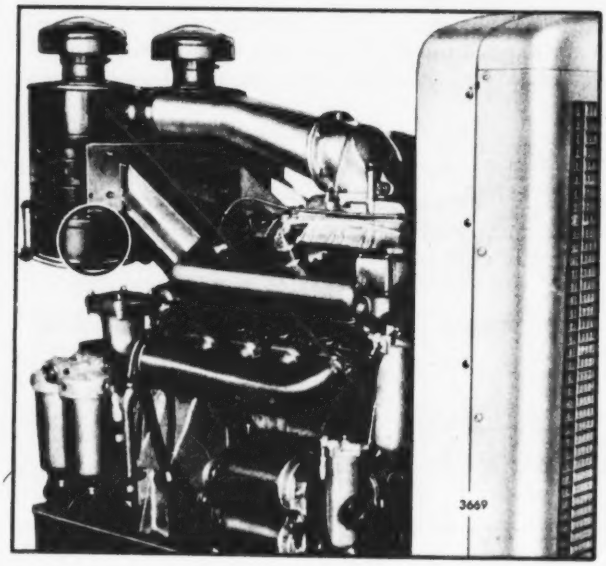
must not exceed 6 inches of mercury. At normal operating speeds (1600-2100 rpm), the fuel pressure is 45 to 70 psi (310-483 kPa). Change the fuel filter elements whenever the inlet restriction (suction) at the fuel pump reaches 12 inches of mercury at normal operating speeds and whenever the fuel pressure at the inlet manifold falls to 45 psi (310 kPa). Refer to Table 1.

Item 10

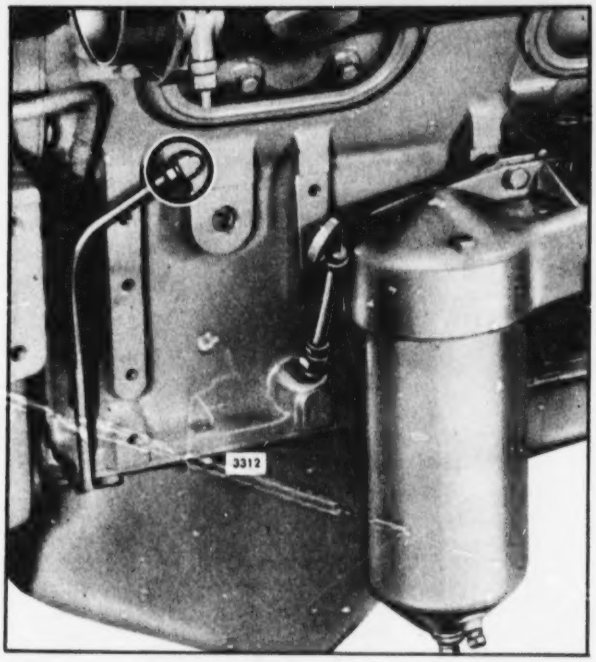
Remove the dirty oil and sludge from the oil bath type air cleaner cups and center tubes every 8 hours, or less if operating conditions warrant. Wash the cups and elements in clean fuel oil and refill the cups to the level mark with the same grade and viscosity of *heavy duty* oil as used in the engine. The frequency of servicing may be varied to suit local dust conditions.

It is recommended that the body and fixed element in the heavy-duty oil bath type air cleaner be serviced every 500 hours, 15,000 miles (24 140 km) or as conditions warrant.

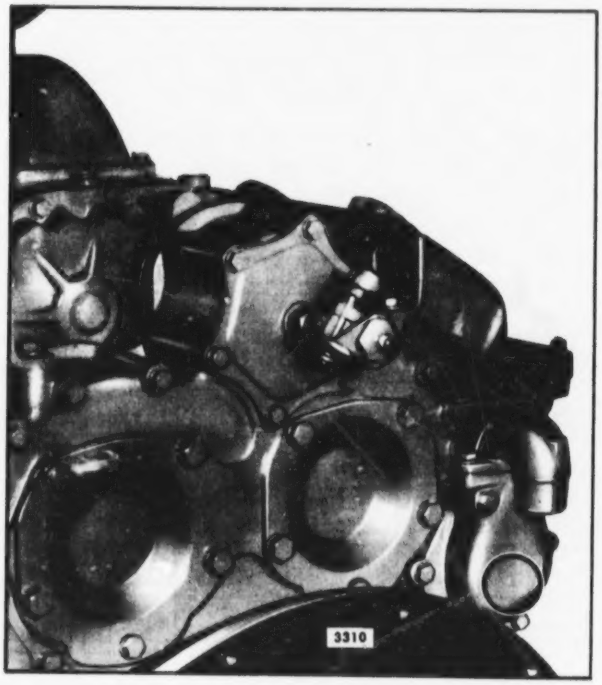
Clean or replace the element in the dry-type air cleaner when the restriction indicator instrument indicates high restriction or when a water manometer reading at the air inlet housing indicates the maximum allowable air inlet restriction (refer to the *Air Inlet Restriction* chart in the *Trouble Shooting* section). Refer to the instructions in the *Air System* section for servicing the dry-type air cleaner.



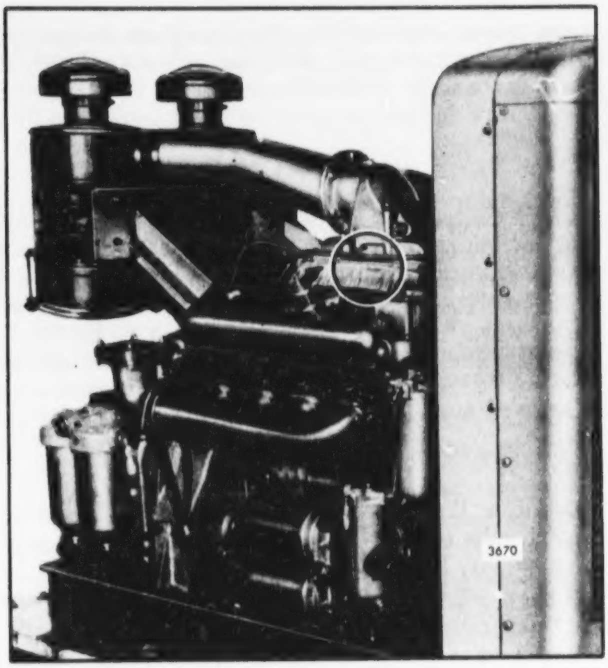
Item 10



Item 11



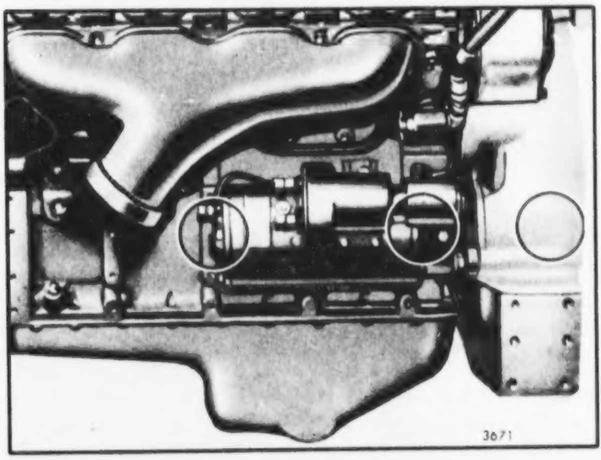
Item 12



Item 13

Item 11

With the engine running, check for flow of air from the air box drain tubes every 1,000 hours or 30,000 miles (48 280 km). If the tubes are clogged, remove, clean and reinstall the tubes. The air box drain tubes should be cleaned periodically even though a clogged condition is not apparent. If the engine is equipped with an air box drain tank, drain the sediment periodically.



Item 14

Item 12

Remove the crankcase breather, if it is mounted on the flywheel housing, every 1,000 hours or 30,000 miles (48 280 km) and wash the steel mesh pad in fuel oil and dry it with compressed air. This cleaning period may be reduced or lengthened according to severity of service.

Clean the internally mounted breather pads at time of engine overhaul, or sooner if excessive crankcase pressure is observed.

Clean the breather cap, mounted on the valve rocker cover, in clean fuel oil every time the engine oil is changed.

Item 13

Inspect the blower screen and gasket assemblies (if used) every 1,000 hours or 30,000 miles (42 280 km) and, if necessary, clean the screens in fuel oil and dry them with compressed air. Reinstall the screen and gasket assemblies with the screen side of the assemblies toward the blower. Inspect for evidence of blower seal leakage.

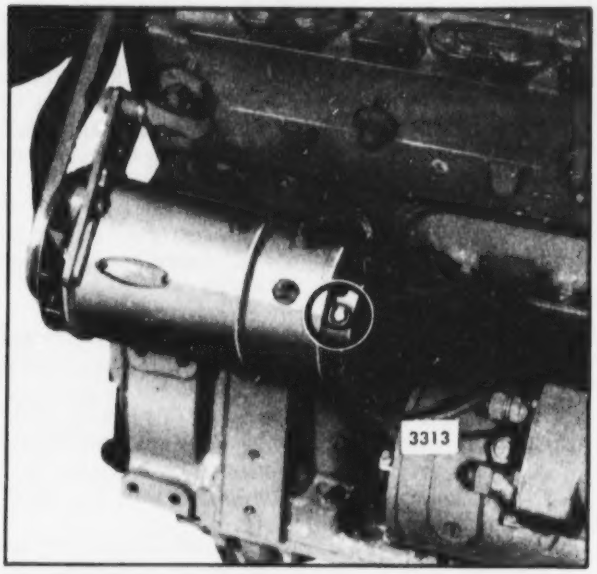
Item 14

The electrical starting motor is lubricated at the time of original assembly. Oil can be added to the oil wicks, which project through each bushing and contact the armature shaft, by removing the pipe plugs on the outside of the motor. The wicks should be lubricated whenever the starting motor is taken off the engine or disassembled.

The Sprag overrunning clutch drive mechanism should be lubricated with a few drops of light engine oil whenever the starting motor is overhauled.

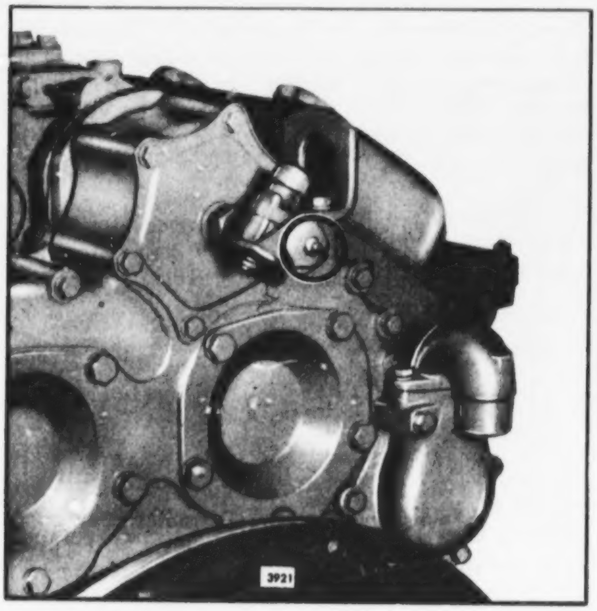
Item 15

Lubricate the battery-charging alternator bearings or bushings with 5 or 6 drops of engine oil at the hinge cap oiler every 200 hours or 6,000 miles (9 656 km). Some alternators have a built-in supply of grease, while others use sealed bearings. In these latter two cases, additional lubrication is not necessary.



Item 15

On A.C. alternators, the slip rings and brushes can be inspected through the end frame assembly. If the slip rings are dirty, they should be cleaned with 400 grain or finer polishing cloth. Never use emery cloth to clean the slip rings. Hold the polishing cloth against the slip rings with the alternator in operation and blow away all dust after the cleaning operation. If the slip rings are rough or out of round, replace them. Inspect the terminals for corrosion and loose connections and the wiring for frayed insulation.



Item 17

Item 16

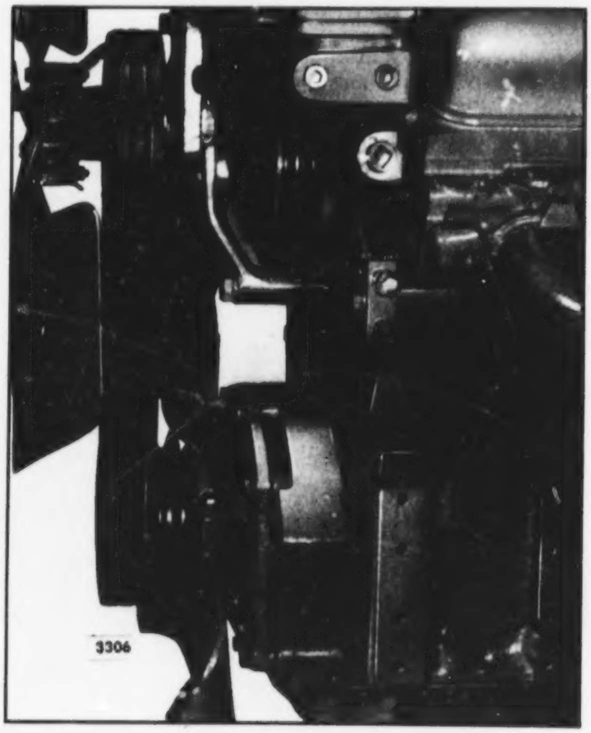
Check the specific gravity of the electrolyte in each cell of the battery every 100 hours or 3,000 miles (4 828 km). In warm weather, however, it should be checked more frequently due to a more rapid loss of water from the electrolyte. The electrolyte level should be maintained in accordance with the battery manufacturer's recommendations.

Item 17

Lubricate the tachometer drive every 100 hours or 3,000 miles (4 828 km) with an all purpose grease at the grease fitting. At temperatures above +30°F (−1°C), use a No. 2 grade grease. Use a No. 1 grade grease below this temperature.

Item 18

Lubricate the throttle control mechanism every 200 hours or 6,000 miles (9 656 km) with an all purpose



Item 20

grease at the grease fittings. At temperatures above +30°F (–1°C), use a No. 2 grade grease. Use a No. 1 grade grease below this temperature. Lubricate all other control mechanisms, as required, with engine oil.

Item 19

There is no scheduled interval for performing an engine tune-up. As long as the engine performance is satisfactory, a complete tune-up is not required. Minor adjustments in the valve and injector operating mechanisms and governor should only be required periodically to compensate for normal wear on parts.

Item 20

New standard V-belts will stretch after the first few hours of operation. Run the engine for 15 *seconds* to seat the belts, then re-tension them. Retighten the fan drive, pump drive, battery-charging alternator and other accessory drive belts after 1/2 hour or 15 miles (24 km) and again after 8 hours or 240 miles (386 km) of operation. Thereafter, check the tension of the drive belts every 200 hours or 6,000 miles (9 656 km) and adjust, if necessary. Too tight a belt is destructive to the bearings of the driven part; a loose belt will slip.

Replace all belts in a set when one is worn. Single belts of similar size should not be used as a substitute for a matched belt set; premature belt wear can result because of belt length variation. All belts in a matched belt set are within .032″ of their specified center distances.

Adjust the belt tension so that a firm push with the thumb, at a point midway between the two pulleys, will depress the belt 1/2″ to 3/4″. If belt tension gage BT-33-73FA or equivalent is available, adjust the belt tension as outlined in Table 2.

"V" and "POLY V" BELT TENSION TABLE (1 lbs/belt)

Model	Fan Drive			Alternator or Generator Drive		
	10 Rib (L) Poly V Belt	2 or 3 Belts	Single Belt	Two 3/8" or 1/2" Belts	One 1/2" Belt	8 Rib (K) Poly V Belts
6, 8V-71		60-80	80-100	40-50	50-70	110-130
12V-71		70-90		40-50	50-70	
16V-71	310-360	90-120		40-50	50-70	

Belt tension is 50-70 for a single premium high capacity belt (.785" wide) used to drive a 12 cfm air compressor.

Adjust all V-belts with belt tension gage BT-33-73 FA or equivalent.

Adjust all Poly V-belts with belt tension gage *BT-33-AE6-40A (Burroughs) or equivalent J23586 (Kent Moore) *Range 60-400 lbs

TABLE 2

> **NOTE:** When installing or adjusting an accessory drive belt, be sure the bolt at the accessory adjusting pivot point is properly tightened, as well as the bolt in the adjusting slot.

Adjust Poly-V Fan Belt (16V-71)

The fan belt should be neither too tight nor too loose. Carelessness in making a belt adjustment can be dangerous. Too tight a belt imposes an undue load on the fan bearings and shortens the life of the belt. Too loose a belt allows slippage and lowers the fan speed, causes excessive belt wear and leads to overheating of the cooling system.

Before a Poly-V belt is installed, it is very important that the crankshaft pulley (10 grooves) and the fan drive pulley (11 grooves) are in alignment. The extra groove in the fan drive pulley can be on the inside or the outside of the pulley, depending upon alignment requirements.

Misalignment between the crankshaft pulley and the fan drive pulley cannot be more than .009″ per inch of center line distance. A straight line can be determined by placing a straight edge on the rims of the pulleys. A spacer is available to facilitate pulley alignment, if necessary. The spacer mounts between the crankshaft pulley and the vibration damper hub.

Poly-V belts require a special procedure for proper belt tension.

1. After the belts have been initially adjusted, run the engine under a light load for one-half hour.

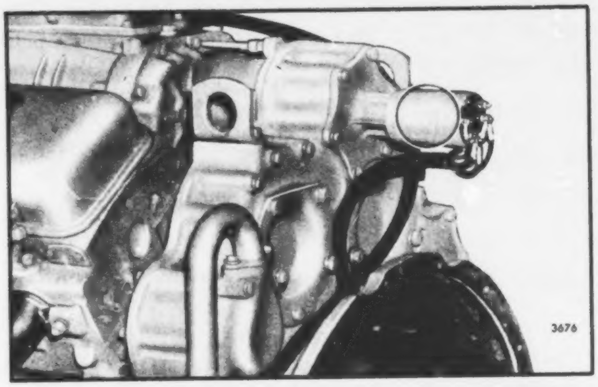
2. Stop the engine and check the belt tension with the belt "hot"; use belt tension gage BT-33-86AE6-40A, or equivalent, which has a range of 60 to 400 pounds.

3. If the tension value is not between 280 and 360 pounds, re-adjust the belt tension.

> **CAUTION:** Because the allowable load the crankshaft bearing can carry is critical, do not exceed the maximum tension value of 360 pounds.

4. Run the engine at full load for eight hours and then recheck the belt tension.

5. If the belt tension is too tight or too loose, keep the gage in place and adjust the belt tension, to the prescribed value, at the accessory mounting or



Item 21

adjusting bolts. Retighten all of the bolts to the proper torque.

6. The belt tension should be rechecked every 200 hours of engine operation and readjusted, if necessary.

Item 21

Lubricate the overspeed governor, if it is equipped with a hinge cap oiler or oil cup, with 5 or 6 drops of engine oil every 500 hours. Avoid excessive lubrication and do not lubricate the governor while the engine is running.

Item 22

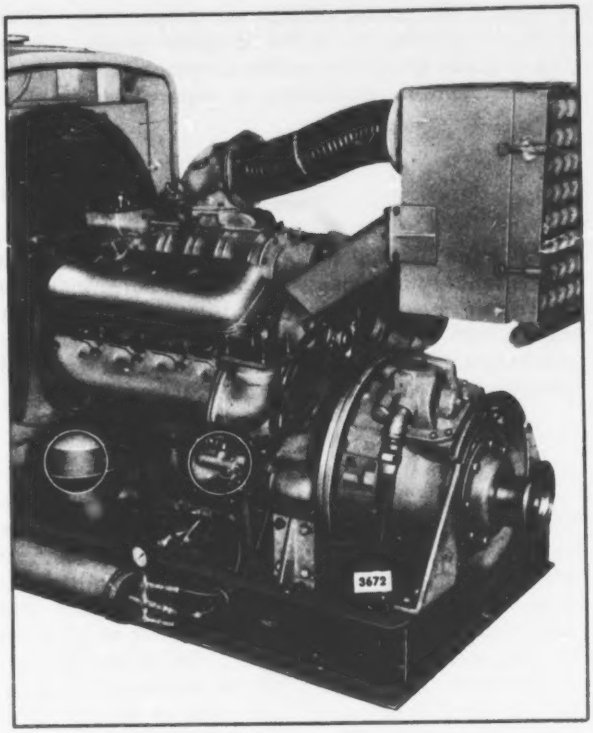
If the fan bearing hub assembly is provided with a grease fitting, use a hand grease gun and lubricate the bearings with one shot of Texaco Premium RB grease, or an equivalent Lithium base multi-purpose grease, every 20,000 miles or 32 187 km (approximately 700 hours).

Every 4,000 hours, clean, inspect and repack the fan bearing hub assembly with the above recommended grease.

At a major engine overhaul, remove and discard the bearings in the fan hub assembly. Pack the hub assembly, using new bearings, with Texaco Premium RB grease, or an equivalent Lithium base multi-purpose grease.

Item 23

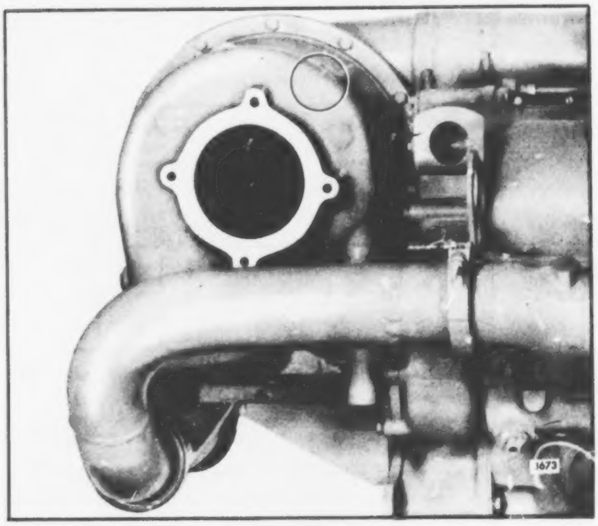
Check the shutdown system every 300 operating hours or each month to be sure it will function when needed.



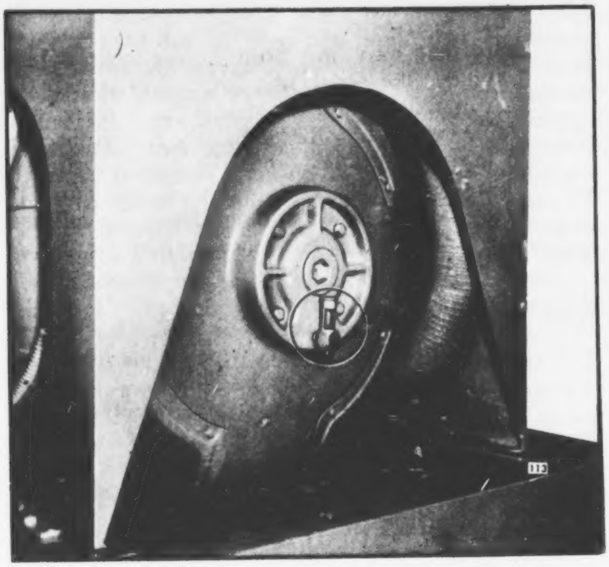
Item 24

Item 24

On engines equipped with a hydrostarter, refer to the *Hydraulic Starting System* in the section on *Engine Equipment* for preventive maintenance and lubrication.



Item 26



Item 28

Item 25

To clean either the hair or polyurethane type air compressor air strainer element, saturate and squeeze it in fuel oil, or any other cleaning agent that would not be detrimental to the element, until dirt free. Then dip it in lubricating oil and squeeze it dry before placing it back in the air strainer.

For replacement of the air strainer element, contact the nearest Bendix Westinghouse dealer; replace with the polyurethane element, if available.

Item 26

There is no scheduled interval for performing an inspection on the turbocharger. As long as the turbocharger is operating satisfactorily and there is no appreciable loss of power, no vibration or unusual noise and no oil leaks, only a periodic inspection is necessary. When service is required, contact an authorized *Detroit Diesel Allison Service Outlet*.

Item 27

Check the fan drive fluid level every 75,000 to 100,000 miles (120 701 to 160 934 km) to avoid improper operation and damage to the drive components.

The modulated fan drive has an inspection plug for checking the fluid level.

1. Check the fan drive fluid level after the unit has been idle for at least 1/2 hour.

2. Turn the fan drive so that the inspection plug is 3/4" below the horizontal center line, then allow the silicone fluid to drain down an additional five minutes.

3. Remove the inspection plug. If fluid begins to flow from the inspection hole, the drive has sufficient fluid. Replace the inspection plug.

4. If the fluid does not flow from the hole, proceed as follows:

   a. Rotate the fan drive downward and observe when the fluid begins to flow from the hole. If it is necessary to lower the drain hole more than 2" below the horizontal center line, the fan drive should be removed from the engine, disassembled and inspected for possible damage to the components.

   b. Turn the fan drive back so the inspection hole is 3/4" below the horizontal center line and add fluid until the overflow point is reached. Replace the inspection plug.

NOTE: Use only the manufacturer's Special 20 Cenistroke fluid.

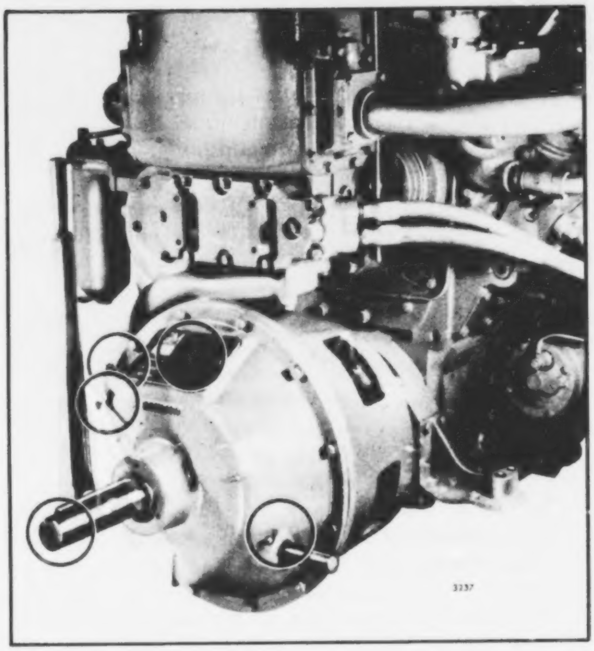
The fan drive bearing should be lubricated with a medium consistency silicone grease (Dow Corning No. 44, or equivalent). The bearing is lubricated through a grease fitting in the drive housing hub.

Item 28

The power generator requires lubrication at only one point -- the ball bearing in the end frame.

If the bearing is oil lubricated, check the oil level in the sight gage every 300 hours; change the oil every six months. Use the same grade and viscosity *heavy-duty* oil as specified for the engine. Maintain the oil level to the line on the sight gage. *Do not overfill.* After adding oil, recheck the oil level after running the generator for several minutes.

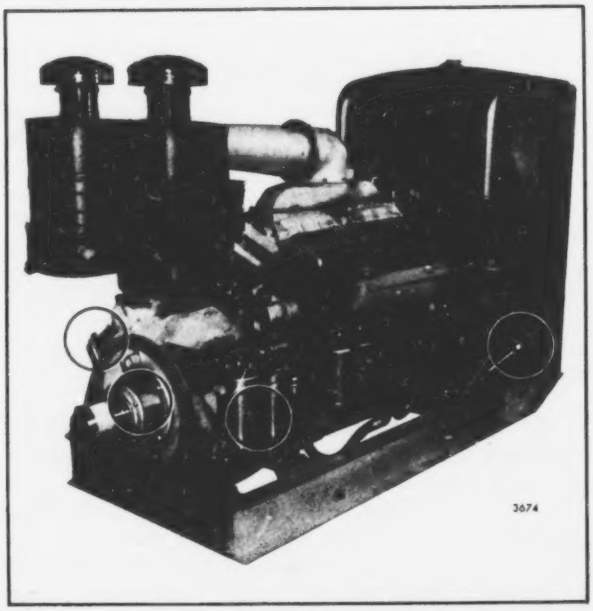
If the bearing is grease lubricated, a new generator has sufficient grease for three years of normal service. Thereafter, it should be lubricated at one year intervals. To lubricate the bearing, remove the filler and relief plugs on the side and the bottom of the bearing reservoir. Add grease until new grease appears at the relief plug opening. Run the generator a few minutes to vent the excess grease; then reinstall the plugs.



Item 29

The following greases, or their equivalents, are recommended:

Keystone 44H	Keystone Lubrication Co.
BRB Lifetime	Socony Vacuum Oil Co.
NY and NJ926 or F927	NY and NJ Lubricant Co.



Item 30

After 100 hours on new brushes, or brushes in generators that have not been in use over a long period, remove the end frame covers and inspect the brushes, commutator and collector rings. If there is no appreciable wear on the brushes, the inspection interval may be extended until the most practicable period has been established (not to exceed six months). To prevent damage to the commutator or the collector rings, do not permit the brushes to become shorter than 3/4 inch.

Keep the generator clean inside and out. Before removing the end frame covers, wipe off the loose dirt. The loose dirt and dust may be blown out with low pressure air (25 psi or 172 kPa maximum). Remove all greasy dirt with a cloth.

Item 29

Lubricate all of the power take-off bearings with an all purpose grease such as Shell Alvania No. 2, or equivalent. Lubricate sparingly to avoid getting grease on the clutch facings.

Lubricate the clutch release bearing and the disconnect mechanical rear drive shaft shielded bearing every 8 hours. The clutch release bearing in the 18" diameter clutch is pre-lubricated and is not provided with a grease fitting, since no further lubrication is required.

Lubricate the power take-off main bearing, also the outboard bearing if the unit is so equipped, every 50 hours. Frequency of lubrication will depend on the working conditions of the bearing, shaft speeds and bearing loads. It may be necessary to lubricate this bearing more often than every 50 hours. Lubricate the front power take-off clutch pilot ball bearing through the fitting in the outer end of the drive shaft every 50 hours. One or two strokes with a grease gun should be sufficient.

Remove the inspection hole cover and lubricate the clutch release levers and link pins sparingly every 500 hours. Lubricate the clutch release shaft through the

OIL RECOMMENDATIONS

Prevailing Ambient Temperature	Recommended Oil Specification
Above −10°F (−23°C)	Hydraulic Transmission Fluid, Type C-2.
Below −10°F (−23°C)	Hydraulic Transmission Fluid, Type C-2. Auxiliary preheat required to raise temperature in the sump to a temperature above −10°F. (−23°C)

TABLE 3

grease fittings on the front of the housing every 500 hours.

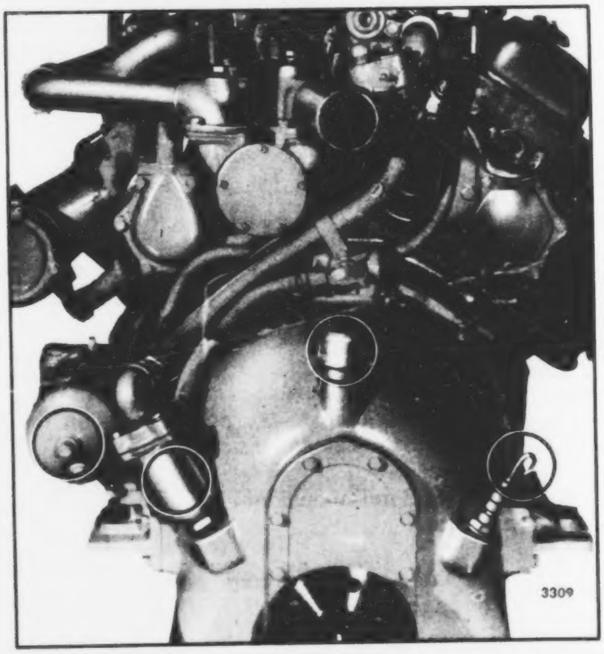
Check the clutch facing for wear every 500 hours. Adjust the clutch if necessary.

Item 30

Check the oil level in the Torqmatic converter and supply tank daily. The oil level must be checked while the converter is operating, the engine idling and the oil is up to operating temperature (approximately 200 °F or 93 °C). If the converter is equipped with an input disconnect clutch, the clutch must be engaged.

Check the oil level after running the unit a few minutes. The oil level should be maintained at the proper level on the dipstick. If required, add hydraulic transmission fluid type "C-2" (see Table 3). *Do not overfill* the converter as too much oil will cause foaming and high oil temperature.

The oil should be changed every 1,000 hours for Series 400 through 900 converters. Also, the oil should be changed whenever it shows traces of dirt or effects of high operating temperature as evidenced by discoloration or strong odor. If the oil shows metal contamination, contact an authorized *Detroit Diesel Allison Service Outlet* as this usually requires disassembly. Under severe operating conditions, the oil should be changed more often.



Item 31

The converter oil breather, located on the oil level dipstick, should be cleaned each time the converter oil is changed. This can be accomplished by allowing the breather to soak in a solvent, then drying it with compressed air.

Lubricate the input clutch release bearing and ball bearing and the front disconnect clutch drive shaft bearing every 50 hours with an all purpose grease. Grease fittings are provided on the clutch housing. This time interval may vary depending upon the operating conditions. Over-lubrication will cause grease to be thrown on the clutch facing, causing the clutch to slip.

The strainer (in the Torqmatic transmission) and the hydraulic system filters should be replaced or cleaned with every oil change.

Item 31

TORQMATIC MARINE GEAR (6 and 8V):

Check the oil level daily in the marine gear, with the controls in neutral and the engine running at idle speed. Add oil as required to bring it to the proper level on the dipstick. Use oil of the same *heavy duty* grade and viscosity that is used in the engine. Drain the oil every 200 hours and flush the gear with light engine oil.

> **NOTE:** Series 3 oil should not be used in the marine gear.

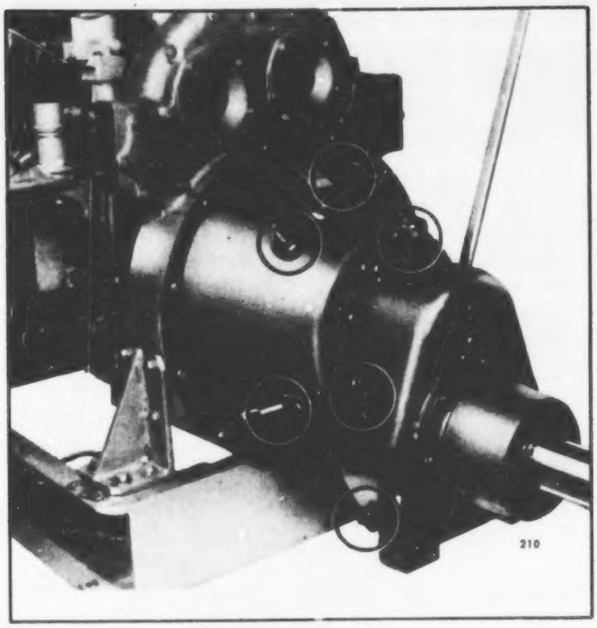
When refilling after an oil drain, bring the oil up to the proper level on the dipstick (approximately 6 quarts (6 litres) in the M type and 8 quarts (8 litres) in the MH type gear). Start and run the engine at light load for three to five minutes. Then put the controls in neutral and run the engine at idle speed and check the oil level again. Bring the oil level up to the proper level on the dipstick.

Every time the marine gear oil is changed, remove the oil strainer element, rinse it thoroughly in fuel oil, dry it with compressed air and reinstall it. Also replace the full-flow oil filter element every time the marine gear oil is changed.

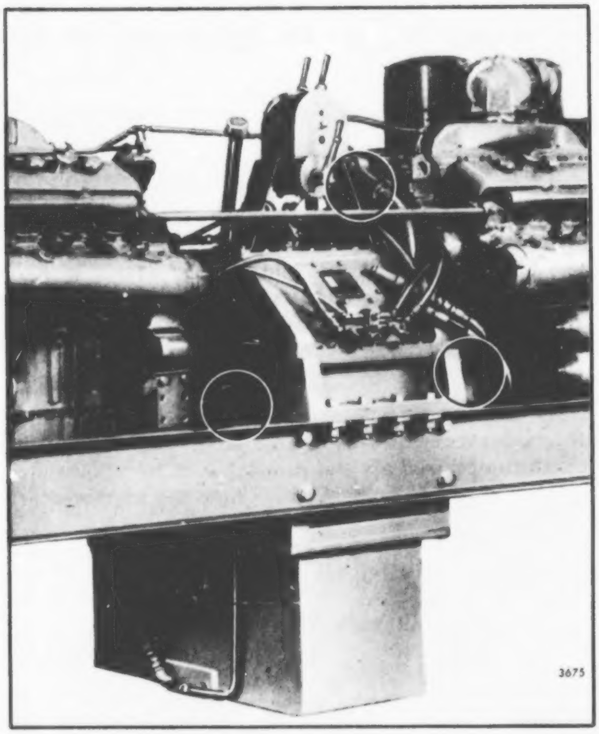
TWIN DISC MARINE GEAR:

Check the oil level daily. Check the oil level with the engine running at low idle speed and the gear in neutral. Keep the oil up to the proper level on the dipstick. Use oil of the same *heavy-duty* grade and viscosity that is used in the engine.

Change the oil and the oil filter element every 1,000 hours. After draining the oil, thoroughly clean the



Item 32



Item 33

removable oil screen and breather. Reinstall the breather and refill the marine gear with oil up to the full mark on the dipstick. Start the engine and, with the gear in neutral, run the engine at idle speed for three to five minutes. Then stop the engine and check the oil level. If necessary, add oil to bring it up to the full mark on the dipstick.

Item 32

ROCKFORD REDUCTION GEAR:

Check the oil level in the reduction gear every 8 hours and add oil as required to bring it to the proper level on the dipstick. Drain the oil every 1,000 hours, flush the housing with light engine oil and refill to the proper level with the same grade and viscosity *heavy duty* oil that is used in the engine. This oil change period should be reduced under severe operating conditions.

Lubricate the clutch release bearing through the grease fitting on the side of the housing every 8 hours of operation. The clutch release bearing in the 18" diameter clutch is pre-lubricated and is not provided with a grease fitting, since no further lubrication is required. Lubricate the front reduction clutch pilot ball bearing through the fitting in the outer end of the drive shaft every 50 hours. One or two strokes with a grease gun should be sufficient.

Remove the inspection hole cover and oil the clutch release levers and link pins sparingly every 500 hours. Lubricate the clutch release shaft through the grease fittings on the front of the housing every 500 hours.

Item 33

REDUCTION GEAR (24V and 32V):

The oil level in the reduction gear should be checked while the gear is in operation. Keep the oil level at the operating level on the dipstick.

Drain the oil every 200 hours of operation. Flush with light engine oil and refill to the proper level on the dipstick (approximately 21 gallons or 79 litres).

> **NOTE:** Series 3 oil should not be used in the reduction gear.

Use oil of the same *heavy duty* grade and viscosity that is used in the engine.

Every time the oil is changed, remove the element from each oil strainer and rinse it thoroughly in clean fuel oil, dry it with compressed air and reinstall.

The filter element of each marine gear oil filter should be removed, the element shell cleaned, and a new element and gasket installed every time the reduction gear oil is changed.

When refilling after an oil drain, bring the oil up to the proper level on the dipstick. Then run the engines to fill the system with oil. Check the oil level on the reduction gear with the engines and gear operating. Bring the oil level up to the proper level on the dipstick. *Do not overfill.*

DETROIT DIESEL FUEL OIL SPECIFICATIONS

GENERAL CONSIDERATIONS

The quality of fuel oil used for high-speed diesel engine operation is a very important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust.

Fuel selected should be completely distilled material. That is, the fuel should show at least 98 percent by volume recovery when subjected to ASTM D-86 distillation. Fuels marketed to meet Federal Specification VV-F-800 (grades DF-1 and DF-2) and ASTM Designation D-975 (grades 1-D and 2-D) meet the completely distilled criteria. Some of the general properties of VV-F-800 and ASTM D-975 fuels are shown below.

FEDERAL SPECIFICATION & ASTM DIESEL FUEL PROPERTIES

Specification or Classification Grade	VV-F-800 DF-1	ASTM D-975 1-D	VV-F-800 DF-2	ASTM D-975 2-D
Flash Point, min.	104° F 40° C	100° F 38° C	122° F 50° C	125° F 52° C
Carbon Residue (10% residuum), % max.	0.15	0.15	0.20	0.35
Water & Sediment % by vol., max.	0.01	trace	0.01	0.05
Ash, % by wt., max.	0.005	0.01	0.005	0.01
Distillation Temperature, 90% by vol. recovery, min.	–	–	–	540°F (282°C)
max.	572°F (300°C)	550°F (288°C)	626°F (330°C)	640°F (338°C)
End Point, max.	626°F (330°C)	–	671°F (355°C)	–
Viscosity 100°F (38°C) Kinematic, cs, min.	1.4	1.4	2.0	2.0
Saybolt, SUS, min.	–	–	–	32.6
Kinematic, cs, max.	3.0	2.5	4.3	4.3
Saybolt, SUS, max.	–	34.4	–	40.1
Sulfur, % by wt., max.	0.50	0.50	0.50	0.50
Cetane No.	45	40	45	40

Residual fuels and domestic furnace oils are not considered satisfactory for Detroit Diesel engines; however, some may be acceptable. (See "DETROIT DIESEL FUEL OIL SPECIFICATIONS.")

NOTE: Detroit Diesel Allison does not recommend the use of drained lubricating oil as a diesel fuel oil. Furthermore, Detroit Diesel will not be responsible for any engine detrimental effects which it determines resulted from this practice.

All diesel fuel oil contains a certain amount of sulfur. Too high a sulfur content results in excessive cylinder wear due to acid build-up in the lubricating oil. For most satisfactory engine life, fuels containing less than 0.5% sulfur should be used.

Fuel oil should be clean and free of contamination. Storage tanks should be inspected regularly for dirt, water or water-emulsion sludge, and cleaned if contaminated. Storage instability of the fuel can lead to the formation of varnish or sludge in the tank. The presence of these contaminants from storage instability must be resolved with the fuel supplier.

DETROIT DIESEL FUEL OIL SPECIFICATIONS

Detroit Diesel Allison designs, develops, and manufactures commercial diesel engines to operate on diesel fuels classified by the ASTM as Designation D-975 (grades 1-D and 2-D). These grades are very similar to grades DF-1 and DF-2 of Federal Specification VV-F-800. Residual fuels and furnace oils, generally, are not considered satisfactory for Detroit Diesel engines. In some regions, however, fuel suppliers may distribute one fuel that is marketed as either diesel fuel (ASTM D-975) or domestic heating fuel (ASTM D-396) sometimes identified as furnace oil. In this case, the fuel should be investigated to determine whether the properties conform with those shown in the "FUEL OIL SELECTION CHART" presented in this specification.

The "FUEL OIL SELECTION CHART" also will serve as a guide in the selection of the proper fuel for various applications. The fuels used must be clean, completely distilled, stable, and non-corrosive. DISTILLATION RANGE, CETANE NUMBER, and SULFUR CONTENT are three of the most important properties of diesel fuels that must be controlled to insure optimum combustion and minimum wear. Engine speed, load, and ambient temperature influence the selection of fuels with respect to distillation range and cetane number. The sulfur content of the fuel must be as low as possible to avoid excessive deposit formation, premature wear, and to minimize the sulfur dioxide exhausted into the atmosphere.

To assure that the fuel you use meets the required properties, enlist the aid of a reputable fuel oil supplier. The responsibility for clean fuel lies with the fuel supplier as well as the operator.

During cold weather engine operation, the cloud point (the temperature at which wax crystals begin to form in diesel fuel) should be 10°F (6°C) below the lowest expected fuel temperature to prevent clogging of the fuel filters by wax crystals.

At temperatures below −20°F (−29°C), consult an authorized Detroit Diesel Allison service outlet, since particular attention must be given to the cooling system, lubricating system, fuel system, electrical system, and cold weather starting aids for efficient engine starting and operation.

FUEL OIL SELECTION CHART

Typical Application	General Fuel Classification	Final Boiling Point	Cetane No.	Sulfur Content
		(Max)	(Min)	(Max)
City Buses	No. 1-D	550°F (288°C)	45	0.30%
All Other Applications	Winter No. 2-D Summer No. 2-D	675°F 675°F (357°C)	45 40	0.50% 0.50%

NOTE: When prolonged idling periods or cold weather conditions below 32°F (0°C) are encountered, the use of lighter distillate fuels may be more practical. The same consideration must be made when operating at altitudes above 5,000 ft.

DETROIT DIESEL LUBRICATING OIL SPECIFICATIONS

GENERAL CONSIDERATIONS

All diesel engines require heavy-duty lubricating oils. Basic requirements of such oils are:

Lubricating Quality
High Heat Resistance
Control of Contaminants

LUBRICATING QUALITY. The reduction of friction and wear by maintaining an oil film between moving parts is the primary requisite of a lubricant. Film thickness and its ability to prevent metal-to-metal contact of moving parts is related to oil viscosity. The optimums for Detroit Diesel engines are SAE 40 or 30 weight.

HIGH HEAT RESISTANCE. Temperature is the most important factor in determining the rate at which deterioration or oxidation of the lubricating oil will occur. The oil should have adequate thermal stability at elevated temperatures, thereby precluding formation of harmful carbonaceous and/or ash deposits.

CONTROL OF CONTAMINANTS. The piston and compression rings must ride on a film of oil to minimize wear and prevent cylinder seizure. At normal rates of consumption, oil reaches a temperature zone at the upper part of the piston where rapid oxidation and carbonization can occur. In addition, as oil circulates through the engine, it is continuously contaminated by soot, acids, and water originating from combustion. Until they are exhausted, detergent and dispersant additives aid in keeping sludge and varnish from depositing on engine parts. But such additives in excessive quantities can result in detrimental ash deposits. If abnormal amounts of insoluble deposits form, particularly on the piston in the compression ring area, early engine failure may result.

Oil that is carried up the cylinder liner wall is normally consumed during engine operation. The oil and additives leave carbonaceous and/or ash deposits when subjected to the elevated temperatures of the combustion chamber. The amount of deposits is influenced by the oil composition, additive content, engine temperature, and oil consumption rate.

DETROIT DIESEL LUBRICATING OIL SPECIFICATIONS

OIL QUALITY

OIL QUALITY is the responsibility of the oil supplier. (The term *oil supplier* is applicable to refiners, blenders, and rebranders of petroleum products, and does not include distributors of such products.)

There are hundreds of commercial crankcase oils marketed today. Obviously, engine manufacturers or users cannot completely evaluate the numerous commercial oils. The selection of a suitable lubricant in consultation with a reliable oil supplier, observance of his oil drain recommendations (based on used oil sample analysis and experience) and proper filter maintenance, will provide the best assurance of satisfactory oil performance.

Detroit Diesel Allison lubricant recommendations are based on general experience with current lubricants of various types and give consideration to the commercial lubricants presently available.

RECOMMENDATION

Detroit Diesel engines have given optimum performance and experienced the longest service life with the following oil performance levels having the ash and zinc limits shown:

Former Military Identification	API Letter Code Service Classification	SAE Grade
MIL-L-2104B/1964MS *	CC/SC	40 or 30 •
Supplement 1 **	CB	40 or 30 •

*Military Specification MIL-L-2104B is obsolete and new developed products can no longer be qualified to meet this performance level. However, many lubricants formulated to meet the performance criteria of MIL-L-2104B/1964MS are still being marketed. Detroit Diesel engines have given optimum performance and experienced the longest service life using MIL-L-2104B/1964MS lubricants. The majority of MIL-L-2104B/1964MS lubricants have a sulfated ash content between 0.55 and 0.85 percent by weight.

**Supplement 1 oils have a history of very satisfactory performance in Detroit Diesel engines. Supplement 1 oils have a relatively low ash content. However, the Supplement 1 oil specification is obsolete and new products cannot be qualified to meet this performance level. Some older formulations are still distributed and used by Detroit Diesel engine customers.

•SAE 40 grade oil has performed satisfactorily and is recommended in Detroit Diesel engines. Obviously, the expected ambient temperatures and engine cranking capability must be considered by the engine owner/operator when selecting the proper grade of oil. Only when the ambient temperatures and engine cranking capabilities result in difficult starting should SAE 30 grade oil be used.

ASH LIMIT

The sulfated ash (ASTM D-874) limit of all the lubricants recommended or selected as alternates for use in Detroit Diesel engines shall not exceed 1.000 percent by weight, except lubricants that contain only barium detergent-dispersant salts where 1.500 percent by weight is allowed. Lubricants having a sulfated ash content between 0.55 and 0.85 percent by weight have a history of excellent performance in Detroit Diesel engines. Lubricants having a sulfated ash content greater than 0.85 percent by weight are prone to produce greater deposit levels in the ring belt and exhaust valve areas of the engine.

ZINC CONTENT

The zinc content, as zinc diorganodithiophosphate, of all the lubricants recommended or selected as alternates for use in Detroit Diesel engines shall be a minimum of 0.07 percent by weight. However, where EMD or RR oils are used in marine service applications, the minimum zinc content is not required.

ALTERNATE LUBRICANT SELECTIONS

Current Military or Industry Accepted Identification	API Letter Code Service Identification	SAE Grade
MIL-L-2104C ***	CD/SC	40 or 30
MIL-L-46152 ***	CC/SE	40 or 30
Universal ***	Numerous	40 or 30

***Some lube suppliers have superseded the obsolete MIL-L-2104B oils with either MIL-L-2104C, MIL-L-46152, or Universal lubricants. Generally, all of the above oil performance levels contain a higher sulfated ash content than the older MIL-L-2104B/1964MS lubricants. Ring belt and exhaust valve deposits are usually greater when higher ash lubricants are used. Excessive deposit formation in these areas may result in stuck rings and/or guttered valves.

MIL-L-2104C, MIL-L-46152, or Universal lubricants may be used if they meet the sulfated ash and zinc limits shown elsewhere in this specification and sufficient evidence of satisfactory performance in Detroit Diesel engines has been provided to the customer by the oil supplier.

LUBRICANTS NOT RECOMMENDED

The following lubricants are NOT recommended because of a history of poor performance in Detroit Diesel engines:

Former Military or Industry Accepted Identification	API Letter Code Service Classification	Comment on Performance
MIL-L-2104B/1968MS	CC/SD	Excessive ash deposits formed
MIL-L-45199B (Series 3)	CD	Excessive ash deposits formed
All Multigrade Oils	Numerous	History of poor performance

MULTIGRADE OILS

Detroit Diesel does NOT recommend the use of multigrade oils. Recent investigations with some multigrade oils indicate they do NOT, generally, exhibit the antiscuffing and antiwear properties obtained from straight SAE 40 and 30 grade oils operating in the same service applications. Neither fuel or oil consumption rates were improved using multigrade lubricants. Detroit Diesel engines literally create their own environment after they have been started and warmed up. It is during the operational mode under load that the straight SAE 40 and 30 grade lubricants have provided more satisfactory service than multigrade oils. Detroit Diesel will continue to investigate the performance of multigrade oils.

SYNTHETIC OILS

The performance of single grade (e.g., SAE 40 or 30) synthetic oils is comparable to the performance of single grade mineral base oils. However, where low viscosity lubricants are required for cold starting, synthetic multigrade oils have shown significantly improved performance over mineral base multigrade oils. Multigrade synthetic oils are not as satisfactory as single grade mineral or synthetic SAE 40 or 30 oils where the latter can be used.

If a lubricant meets MIL-L-2104B or MIL-L-2104C oil performance requirements and the sulfated ash and zinc limits shown elsewhere in this specification, it qualifies for use in Detroit Diesel engines. The base stock may be either mineral or synthetic. It is the performance level (i.e., MIL-L-2104B) and properties (i.e., ash and zinc contents) that are significant. Refer to MIL-L-46167 Arctic Lube Oil Section of this specification.

COLD WEATHER OPERATION

Cold weather starting will be facilitated when immersion type electrical coolant heaters can be used. Other practical considerations, such as the use of batteries, cables and connectors of adequate size, generators or alternators of ample capacity, proper setting of voltage regulators, ether starting aids, oil and coolant heater systems, and proper fuel selection will accomplish starting with the use of SAE 40 or SAE 30 oils. For complete cold weather starting information, consult an authorized Detroit Diesel Allison service outlet. Ask for Engineering Bulletin No. 38 entitled, *Cold Weather Operation of Detroit Diesel Engines.*

MIL-L-46167 ARCTIC LUBE OILS FOR NORTH SLOPE & OTHER EXTREME SUB-ZERO OPERATIONS

The MIL-L-46167 specification was published by the Military on 15 February, 1974. Federal Test Method 354 of Federal Test Standard 791 is an integral test requirement of MIL-L-46167. *Lubricants that have passed the oil performance requirement limits of Method 354 may be used where continuous sub-zero temperatures prevail and where engines are shut down for periods longer than eight (8) hours.* The lubricants that have shown the best performance when subjected to Method 354 evaluation may be described as multigrades having a synthetic base stock and low volatility characteristics. These lubricants are not comparable to the performance of SAE 40 or 30 oils after the engine has started and is operating at normal engine temperature conditions. For this reason, MIL-L-46167 lubricants should be considered only as a last resort when engine cranking is a severe problem and auxiliary heating aids are not available.

EMD OR RR OILS

Lubricants specified by Electro-Motive Division of General Motors Corporation (EMD) are special lubricants. Generally, these may be described as SAE 40 fluids that possess low Viscosity Index (VI) properties and do not contain any or very low concentrations of zinc ingredients. They are identified by industry as EMD or railroad (RR) oils. They are an approved option for Series 149 engines in all marine applications and for all other model Detroit Diesel engines used for auxiliary power in marine service applications.

OIL CHANGES

Oil change intervals are dependent upon the various operating conditions of the engines and the sulfur content of the diesel fuel used. Oil drain intervals in all service applications may be increased or decreased with experience using a specific lubricant, while also considering the recommendations of the oil supplier. Generally, the sulfur content of diesel fuels supplied throughout the U.S.A. and Canada are low (i.e., less than 0.5 per cent by weight—ASTM D-129 or D-1552 or D-2622). Fuels distributed in some overseas locations may contain higher concentrations of sulfur, the use of which will require reduced lube oil drain intervals.

Highway Trucks & Inter-City Buses (Series 53, 71, and 92 Naturally Aspirated and Turbocharged Engines)

For highway trucks and buses, used for inter-city operation, the oil change interval is 100,000 miles. The drain interval may be extended beyond this point if supported by the results obtained from used lube oil analysis; it is recommended that you consult with your lube oil supplier in establishing any drain interval exceeding 100,000 miles.

City Transit Coaches and Pick-Up and Delivery Truck Service (Series 53, 71, and 92 Naturally Aspirated and Turbocharged Engines)

For city transit coaches and pick-up and delivery truck service, the oil change interval is 12,500 miles. The oil drain interval may be extended beyond 12,500 miles if supported by used oil analyses.

Industrial and Marine (Series 53, 71, and 92 Naturally Aspirated and Turbocharged Engines)

Series 53, 71, and 92 engines, in industrial and marine service, should be started with 150-hour oil change periods. The oil drain intervals may be extended if supported by used oil analyses.

Large Industrial and Marine (Series 149 Naturally Aspirated and Turbocharged Engines)

The recommended oil change period for naturally aspirated Series 149 engines is 500 hours, while the change period for turbocharged Series 149 engines is 300 hours. These drain intervals may be extended if supported by used oil analyses.

Used Lube Oil Analysis Warning Values

The presence of ethylene glycol in the oil is damaging to the engine. Its presence and need for an oil change and for corrective maintenance action may be confirmed by glycol detector kits which are commercially available.

Fuel dilution of the oil may result from loose fuel connections or from prolonged engine idling. A fuel dilution exceeding 2.5 percent by volume indicates an immediate need for an oil change and corrective maintenance action. Fuel dilution may be confirmed by ASTM D-322 test procedure performed by oil suppliers or independent laboratories.

In addition to the above considerations, if any of the following occur, the oil should be changed:

1. The viscosity at 100° F. of a used oil sample is 40 percent greater than the viscosity of the unused oil measured at the same temperature (ASTM D-445 and D-2161).
2. The iron content is greater than 150 parts per million.
3. The pentane insolubles (total contamination) exceed 1.00 percent by weight (ASTM D-893).
4. The total base number (TBN) is less than 1.0 (ASTM D-664). Note: The sulfur content of the diesel fuel used will influence the alkalinity of the lube oil. With high sulfur fuels, the oil drain interval will have to be shortened to avoid excessive acidity in the lube oil.

LUBE OIL FILTER ELEMENT CHANGES

Full-Flow Filters

A full-flow oil filtration system is used in all Detroit Diesel engines. To insure against physical deterioration of the filter element, it should be replaced at a *maximum* of 25,000 miles for on-highway vehicles or at each oil change period, whichever occurs first. For all other applications, the filter should be replaced at a *maximum* of 500 hours or at each oil change period, whichever occurs first.

By-Pass Filters

Auxiliary by-pass lube oil filters are not required on Detroit Diesel engines.

NEW ENGINE OIL CLASSIFICATION SYSTEM

A relatively new engine oil classification system has been introduced to industry that describes the criteria required to meet each performance level. A simplified cross-reference of oil and current commercial and military specifications is shown below.

CROSS-REFERENCE OF LUBE OIL CLASSIFICATION SYSTEMS

API Code Letters	Comparable Military or Commercial Industry Spec.
CA	MIL-L-2104A
CB	Supplement 1
CC	MIL-L-2104B (see Note below)
CD	MIL-L-45199B (Series 3)
‡	MIL-L-46152 (supersedes MIL-L-2104B for Military only)
■	MIL-L-2104C (supersedes MIL-L-45199B for Military only)
SA	none
SB	none
SC	1964 MS oils — Auto passenger car
SD	1968 MS oils — Auto passenger car
SE	1972 MS oils — Auto passenger car

‡ Oil performance meets or exceeds that of CC and SE oils.

■ Oil performance meets or exceeds that of CD and SC oils.

NOTE: MIL-L-2104B lubricants are currently marketed and readily available for commercial use. MIL-L-2104B lubricants are obsolete for Military service applications only.

Consult the following publications for complete descriptions:

1. Society of Automotive Engineers (SAE) Technical Report J-183a.
2. Federal Test Method Standard 791a.

PUBLICATION AVAILABLE SHOWING COMMERCIAL "BRAND" NAME LUBRICANTS

A list of "brand" name lubricants distributed by the majority of worldwide oil suppliers can be purchased from the Engine Manufacturers Association (EMA). The publication is titled, *EMA Lubricating Oils Data Book for Heavy-Duty Automotive and Industrial Engines.* The publication shows the brand names, oil performance levels, viscosity grades, and sulfated ash contents of most "brands" marketed.

ENGINE MANUFACTURERS ASSOCIATION
111 EAST WACKER DRIVE
CHICAGO, ILLINOIS 60601

STATEMENT OF POLICY ON FUEL AND LUBRICANT ADDITIVES

In answer to requests concerning the use of fuel and lubricating oil additives, the following excerpt has been taken from a policy statement of General Motors Corporation:

> *"It has been and continues to be General Motors policy to build motor vehicles that will operate satisfactorily on the commercial fuels and lubricants of good quality regularly provided by the petroleum industry through retail outlets."*

Therefore, Detroit Diesel Allison does not recommend the use of any supplementary fuel or lubricant additives. These include all products marketed as fuel conditioners, smoke suppressants, masking agents, reodorants, tune-up compounds, top oils, break-in oils, graphitizers, and friction-reducing compounds.

NOTE: The manufacturer's warranty applicable to Detroit Diesel engines provides in part that the provisions of such warranty shall not apply to any engine unit which has been subject to misuse, negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's fuel or lubricating recommendations may not be within the coverage of the warranty.

SERVICE AND INSPECTION INTERVALS

Generally, operating conditions will vary for each engine application, even with comparable mileage or hours and, therefore, maintenance schedules can vary. A good rule of thumb for piston, ring, and liner inspections, however, would be at 45,000 miles or 1500 hours for the first such inspection and at 30,000 miles or 1000 hour intervals thereafter.

ENGINE COOLANT

Engine coolant is considered as any solution which is circulated through the engine to provide the means for heat transfer from the various engine components. In general, water containing various materials in solution is used for this purpose.

The function of the coolant is basic to the design and to the successful operation of the engine. Therefore, coolant must be carefully selected and properly maintained.

COOLANT REQUIREMENTS

A suitable coolant solution must meet the following basic requirements:

1. Provide for adequate heat transfer.

2. Provide a corrosion resistant environment within the cooling system.

3. Prevent formation of scale or sludge deposits in the cooling system.

4. Be compatible with the cooling system hose and seal materials.

5. Provide adequate freeze protection during cold weather operation.

The first four requirements are satisfied by combining a suitable water with reliable inhibitors. When operating conditions dictate the need for freeze protection, a solution of suitable water and a permanent type antifreeze containing adequate inhibitors will provide a satisfactory coolant.

WATER

Any water, whether of drinking quality or not, will produce a corrosive environment in the cooling system. Also, scale deposits may form on the internal surfaces of the cooling system due to the mineral content of the water. Therefore, water selected as a coolant must be properly treated with inhibitors to control corrosion and scale deposition.

To determine if a particular water is suitable for use as a coolant when properly inhibited, the following characteristics must be considered: the concentration of chlorides, sulfates, total hardness and dissolved solids. Chlorides and/or sulfates tend to accelerate corrosion, while hardness (percentage of magnesium and calcium present) causes deposits of scale. Total dissolved solids may cause scale deposits, sludge deposits, corrosion or a combination of these. Chlorides, sulfates, magnesium and calcium are among but not necessarily all the materials which make up dissolved solids. Water, within the limits specified in Tables 1 and 2 of Figure 1, is satisfactory as an engine coolant when proper inhibitors are added.

CORROSION INHIBITORS

A corrosion inhibitor is a water soluble chemical

TABLE 1

	PARTS PER MILLION	GRAINS PER GALLON
Chlorides (Maximum)	40	2.5
Sulfates (Maximum)	100	5.8
Total Dissolved Solids (Maximum)	340	20
Total Hardness (Maximum)	170	10

Refer to Table 2 for evaluation of water intended for use in a coolant solution.

TABLE 2

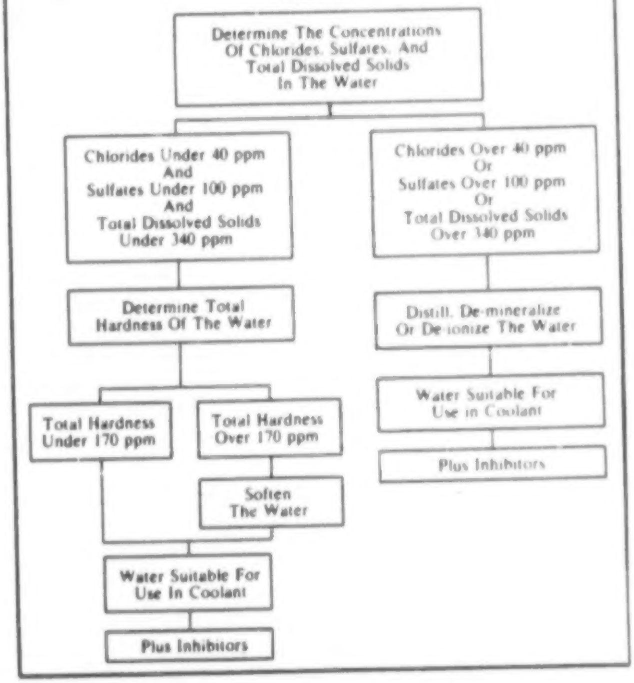

Determine The Concentrations Of Chlorides, Sulfates, And Total Dissolved Solids In The Water
Chlorides Under 40 ppm And Sulfates Under 100 ppm And Total Dissolved Solids Under 340 ppm
Chlorides Over 40 ppm Or Sulfates Over 100 ppm Or Total Dissolved Solids Over 340 ppm
Determine Total Hardness Of The Water
Distill, De-mineralize Or De-ionize The Water
Total Hardness Under 170 ppm
Total Hardness Over 170 ppm
Soften The Water
Water Suitable For Use In Coolant
Plus Inhibitors
Water Suitable For Use in Coolant
Plus Inhibitors

Fig. 1 - Water Characteristics

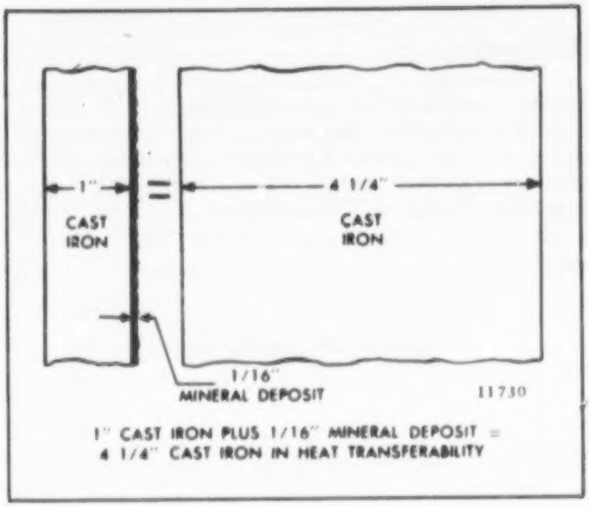

1"
4 1/4"
CAST IRON
CAST IRON
1/16" MINERAL DEPOSIT
11730
1" CAST IRON PLUS 1/16" MINERAL DEPOSIT = 4 1/4" CAST IRON IN HEAT TRANSFERABILITY

Fig. 2 - Heat Transfer Capacity

compound which protects the metallic surfaces of the cooling system against corrosive attack. Some of the more commonly used corrosion inhibitors are chromates, borates, nitrates, nitrites and soluble oil. Depletion of all types of inhibitors occur through normal operation. Therefore, strength levels must be maintained by the addition of inhibitors at prescribed intervals. Always follow the supplier's recommendations on inhibitor usage and handling.

NOTE: Methoxy propanol base permanent antifreeze (such as Dowtherm 209, or equivalent) must be re-inhibited only with compatible corrosion inhibitor systems.

Chromates

Sodium chromate and potassium dichromate are two of the best and most commonly used *water* system corrosion inhibitors. However, the restrictive use of these materials, due to ecology considerations, has de-emphasized their use in favor of non-chromates. Care should be exercised in handling these materials due to their toxic nature.

Chromate inhibitors should *not* be used in permanent type antifreeze solutions. Chromium hydroxide, commonly called "green slime", can result from the use of chromate inhibitors with permanent type antifreeze. This material deposits on the cooling system passages, reducing the heat transfer rate (Fig. 2), and results in engine overheating. Engines which have operated with a chromate-inhibited water must be chemically cleaned before the addition of permanent type antifreeze. A commercial heavy duty de-scaler should be used in accordance with the manufacturer's recommendation for this purpose.

Soluble Oil

Soluble oil has been used as a corrosion inhibitor for many years. It has, however, required very close attention relative to the concentration level due to adverse effects on heat transfer if the concentration exceeds 1% by volume. For example: 1-1/4% of soluble oil in the cooling system increases fire deck temperatures 6% and a 2-1/2% concentration raises fire deck temperature up to 15%. Soluble oil is *not* recommended as a corrosion inhibitor.

Non-Chromates

Non-chromate inhibitors (borates, nitrates, nitrites, etc.) provide corrosion protection in the cooling system with the basic advantage that they can be used with either water or a water and permanent type antifreeze solution.

INHIBITOR SYSTEMS

An inhibitor system (Fig. 3) is a combination of chemical compounds which provide corrosion protection, pH control and water softening ability. Corrosion protection has been discussed under the heading *Corrosion Inhibitors*. The pH control is used to maintain an acid free solution. The water softening ability deters formation of mineral deposits. Inhibitor systems are available in various forms such as coolant filter elements, liquid and dry bulk inhibitor additives, and as an integral part of permanent antifreeze.

Coolant Filter Elements

Replaceable elements are available with various chemical inhibitor systems. Compatibility of the element with other ingredients of the coolant solution cannot always be taken for granted.

Problems have developed from the use of the magnesium lower support plate used by some manufacturer's in their coolant filters. The magnesium plate will be attacked by solutions which will not be detrimental to other metals in the cooling system. The dissolved magnesium will be deposited in the hottest zones of the engine where heat transfer is most critical. The use of an aluminum or zinc support plate in preference to magnesium is recommended to eliminate the potential of this type of deposit.

		Inhibitor Compatability			
Inhibitor or Inhibitor System	Corrosion Inhibitor Type	Complete Inhibitor System	Water	Ethylene Glycol Base Antifreeze	*Methoxy Propanol Base Antifreeze
Sodium chromate	Chromate	No	Yes	No	No
Potassium dichromate	Chromate	No	Yes	No	No
Perry filter elements:					
5020 (type OS)	Chromate	Yes	Yes	No	No
S-453 (Spin-on)	Chromate	Yes	Yes	No	No
5030 (type OS)	@Non-chromate	Yes	Yes	Yes	No
S-331 (Spin-on)	@Non-chromate	Yes	Yes	Yes	No
5070 (type OS)	# Non-chromate	Yes	Yes	Yes	No
S-473 (Spin-on)	# Non-chromate	Yes	Yes	Yes	No
Lenroc filter element	Non-chromate	Yes	Yes	Yes	No
Fleetguard filter elements:					
DCA (canister)	Non-chromate	Yes	Yes	Yes	No
DCA (Spin-on) (Eth. Gly)	Non-chromate	Yes	Yes	Yes	No
DCA (Spin-on) (Meth. Prop.)	Non-chromate	Yes	No	No	Yes
AC filter elements:					
DCA (canister)	Non-chromate	Yes	Yes	Yes	No
DCA (Spin-on)	Non-chromate	Yes	Yes	Yes	No
Luber-Finer filter elements:					
LW-4739 (canister)	Non-chromate	Yes	Yes	Yes	No
LFW-4744 (spin-on)	non-chromate	Yes	Yes	Yes	No
Nalcool 2000 (liquid)	Non-chromate	Yes	Yes	Yes	No
Perry LP-20 (liquid)	Non-chromate	Yes	Yes	Yes	No
Sy-Cool (liquid)	Non-chromate	Yes	Yes	Yes	No
Lubercool (liquid)	Non-chromate	Yes	Yes	Yes	No
Dowtherm cooling system conditioner	Non-chromate	Yes	Yes	Yes	Yes

*Dowtherm 209, or equivalent. @Perry "Year Around" formula. # Perry "Universal" formula.

Fig. 3 - Coolant Inhibitor Chart

High chloride coolants will have a detrimental effect on the water softening capabilities of systems using ion-exchange resins. Accumulations of calcium and magnesium ions removed from the coolant and held captive by the zeolite resin can be released into the coolant by a regenerative process caused by high chloride content solutions.

Bulk Inhibitor Additives

Commercially packaged inhibitor systems are available which can be added directly to the engine coolant or to bulk storage tanks containing coolant solution. Both chromate and non-chromate systems are available and care should be taken regarding inhibitor compatibility with other coolant constituents.

Non-chromate inhibitor systems are recommended for *use in Detroit Diesel engines.* These systems can be used with either water or permanent type antifreeze solutions and provide corrosion protection, pH control and water softening. Some non-chromate inhibitor systems offer the additional advantage of a simple on site test to determine protection level and, since they are added directly to the coolant, require no additional hardware or plumbing.

ANTIFREEZE

When freeze protection is required, a permanent type antifreeze must be used. An inhibitor system is included in this type of antifreeze and no additional inhibitors are required on initial fill if a minimum antifreeze concentration of 30% by volume is used. Solutions of less than 30% concentration do not provide sufficient corrosion protection. Concentrations over 67% adversely affect freeze protection and heat transfer rates (Fig. 4).

Methoxy propanol base antifreeze is not recommended for use in Detroit Diesel engines due to the presence of fluoroelastomer (Viton '0') seals in the cooling system. Before installing ethylene glycol base antifreeze in an engine previously operated with methoxy propanol, the entire cooling system should be drained, flushed with clean water and examined for rust, scale, contaminants, etc. If deposits are present, the cooling system must be chemically cleaned with a commercial grade heavy-duty de-scaler.

Ethylene glycol base antifreeze is recommended for use in Series 71 Detroit Diesel engines. Methyl alcohol antifreeze is *not* recommended because of its effect on the non-metallic components of the cooling system and because of its low boiling point.

The inhibitors in permanent type antifreeze should be replenished at approximately 500 hour or 20,000 mile intervals with a non-chromate inhibitor system. Commercially available inhibitor systems may be used to re-inhibit antifreeze solutions.

Sealer Additives

Several brands of permanent antifreeze are available with sealer additives. The specific type of sealer varies with the manufacturer. Antifreeze with sealer additives is *not recommended* for use in Detroit Diesel engines due to possible plugging throughout various areas of the cooling system.

GENERAL RECOMMENDATIONS

All Detroit Diesel engines incorporate pressurized cooling systems which normally operate at temperatures higher than non-pressurized systems. It is essential that these systems be kept clean and leakfree, that filler caps and pressure relief mechanisms be correctly installed at all times and that coolant levels be properly maintained.

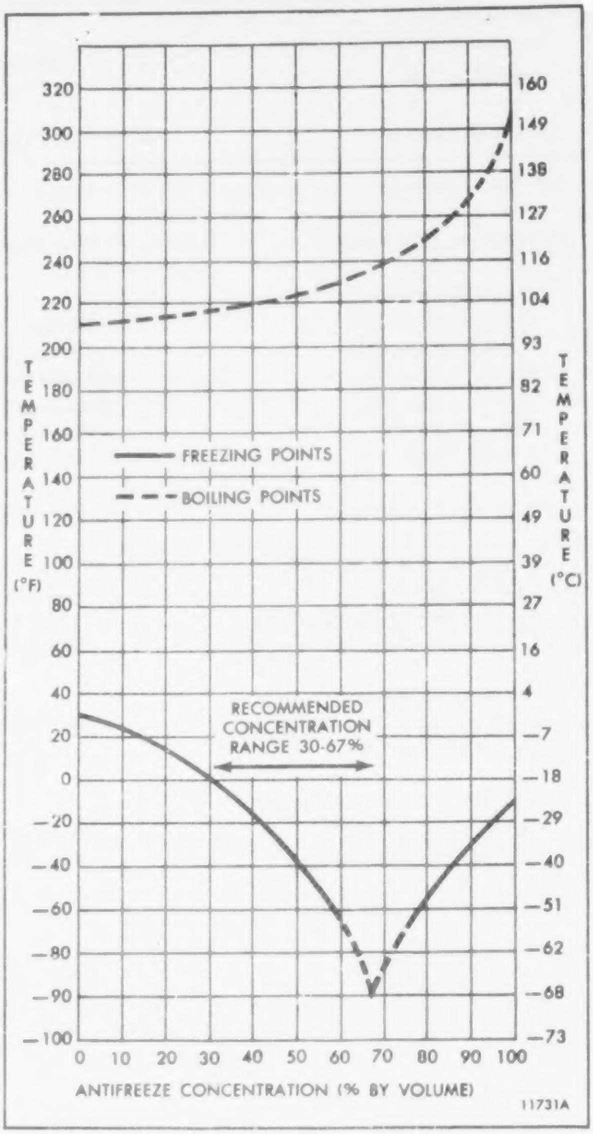


Fig. 4 - Coolant Freezing and Boiling Temperatures Vs Antifreeze Concentration (Sea Level)

WARNING: Use extreme care when removing a radiator pressure control cap from an engine. The sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury (scalding) from the hot liquid.

1. Always use a properly inhibited coolant.

2. Do not use soluble oil.

3. Maintain the prescribed inhibitor strength.

4. Always follow the manufacturer's recommendations on inhibitor usage and handling.

5. If freeze protection is required, always use a permanent type antifreeze.

6. Re-inhibit antifreeze with a recommended non-chromate inhibitor system.

7. Do not use a chromate inhibitor with permanent type antifreeze.

8. Do not use methoxy propanol base antifreeze in Detroit Diesel engines.

9. Do not mix ethylene glycol base antifreeze with methoxy propanol base antifreeze in the cooling system.

10. Do not use an antifreeze containing sealer additives.

11. Do not use methyl alcohol base antifreeze.

12. Use extreme care when removing the radiator pressure control cap.

ENGINE TUNE-UP PROCEDURES

There is no scheduled interval for performing an engine tune-up. As long as the engine performance is satisfactory, no tune-up should be needed. Minor adjustments in the valve and injector operating mechanisms, governor, etc. should only be required periodically to compensate for normal wear on parts.

Four types of governors are used. Since each governor has different characteristics, the tune-up procedure varies accordingly. The four types are:

1. Limiting speed mechanical.

2. Variable speed mechanical.

3. Variable speed hydraulic.

4. Limiting speed hydraulic.

The mechanical engine governors are identified by a name plate attached to the governor housing. The letters D.W. - L.S. stamped on the name plate denote a double-weight limiting speed governor. A single-weight variable speed governor name plate is stamped S.W. - V.S.

Normally, when performing a tune-up on an engine in service, it is only necessary to check the various adjustments for a possible change in the settings. However, if the cylinder head, governor or injectors have been replaced or overhauled, then certain preliminary adjustments are required before the engine is started.

The preliminary adjustments consist of the first four items in the tune-up sequence. The procedures are the same except that the valve clearance is greater for a cold engine.

To tune-up an engine completely, all of the adjustments, except the valve bridge adjustment on four valve cylinder heads, are made by following the applicable tune-up sequence given below, after the engine has reached normal operating temperature. Since the adjustments are normally made while the engine is stopped, it may be necessary to run the engine between adjustments to maintain normal operating temperature.

> **NOTE:** The exhaust valve bridges on the four valve cylinder head are adjusted at the time the cylinder head is installed on the engine and, until wear occurs, no further adjustment is required. When wear is evident, perform a complete valve bridge adjustment as outlined on the following pages.

The tune-up procedures apply to the individual engines of multiple engine units as well as to the single engine units. However, the throttle linkage of multiple engine units must be adjusted after the individual engines have been tuned up.

Tune-Up Sequence for Mechanical Governors

> **CAUTION:** Before starting an engine after an engine speed control adjustment or after removal of the engine governor cover, the serviceman must determine that the injector racks move to the no-fuel position when the governor stop lever is placed in the stop position. Engine overspeed will result if the injector racks cannot be positioned at no-fuel with the governor stop lever.

1. Adjust the exhaust valve clearance.

2. Time the fuel injectors.

3. Adjust the governor gap.

4. Position the injector rack control levers.

5. Adjust the maximum no-load speed.

6. Adjust the idle speed.

7. Adjust the buffer screw.

8. Adjust the throttle booster spring (variable speed governor only).

9. Adjust the supplementary governing device (if used).

Tune-Up Sequence for Hydraulic Governor

1. Adjust the exhaust valve clearance.

2. Time the fuel injectors.

3. Adjust the governor linkage.

4. Position the injector rack control levers.

5. Adjust the load limit screw.

6. Compensation adjustment (PSG governors only).

7. Adjust the governor speed droop.

8. Adjust the maximum no-load speed.

EXHAUST VALVE CLEARANCE ADJUSTMENT

The correct exhaust valve clearance at normal engine operating temperature is important for smooth, efficient operation of the engine.

Insufficient valve clearance can result in loss of compression, misfiring cylinders and, eventually, burned valve seats and valve seat inserts. Excessive valve clearance will result in noisy operation, especially in the low speed range.

Whenever the cylinder head is overhauled, the exhaust valves are reconditioned or replaced, or the valve operating mechanism is replaced or disturbed in any way, the valve clearance must first be adjusted to the cold setting to allow for normal expansion of the engine parts during the engine warm-up period. This will ensure a valve setting that is close enough to the specified clearance to prevent damage to the valves when the engine is started.

ENGINES WITH TWO VALVE CYLINDER HEADS

All of the exhaust valves may be adjusted, in firing order sequence, during one full revolution of the crankshaft. Refer to the *General Specifications* at the front of the manual for the engine firing order.

Exhaust Valve Clearance Adjustment (Cold Engine)

1. Place the governor stop lever in the no-fuel position.

2. Clean the loose dirt from the valve rocker covers and remove the covers. Then cover any drain cavities in the cylinder head to prevent foreign material from entering.

3. Rotate the crankshaft, with the starting motor or engine barring tool J 22582, until the injector follower is fully depressed on the cylinder to be adjusted.

> **CAUTION:** If a wrench is used on the crankshaft or camshaft bolt at the front of the engine, do not turn the engine in a left-hand direction of rotation as the bolt will be loosened.

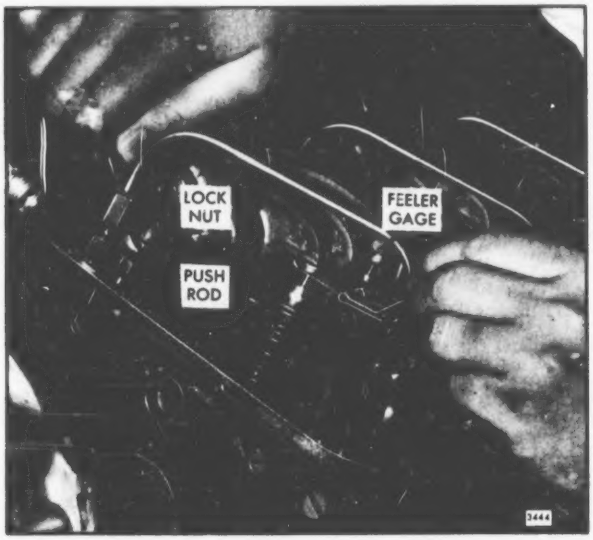


Fig. 1 - Adjusting Valve Clearance

4. Loosen the exhaust valve rocker arm push rod lock nut.

5. Place a .013" feeler gage, tool J 9708, between the valve stem and the rocker arm (Fig. 1). Adjust the push rod to obtain a smooth "pull" on the feeler gage.

6. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

7. Recheck the clearance. At this time, if the adjustment is correct, the .011" feeler gage will pass freely between the valve stem and the rocker arm, but the .013" feeler gage will not pass through.

8. Check and adjust the remaining valves in the same manner as outlined above.

Exhaust Valve Clearance Adjustment (Hot Engine)

Maintaining normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance when running at full load may become insufficient.

With the engine at normal operating temperature (160-185°F or 71-85°C), recheck the exhaust valve clearance with feeler gage J 9708. At this time, if the valve clearance is correct, the .008" feeler gage will pass freely between the valve stem and the rocker arm, but the .010" gage will not pass through.

ENGINES WITH FOUR VALVE CYLINDER HEADS

The exhaust valve bridges must be adjusted and the adjustment screws locked securely at the time the cylinder head is installed on the engine. Until wear occurs, no further adjustment is required on the exhaust valve bridges. When wear is evident, make the necessary adjustments as outlined below.

Exhaust Valve Bridge Adjustment

1. Remove the loose dirt from the valve rocker covers and remove the covers. Remove the injector fuel pipes and the rocker arm bracket bolts. Move the rocker arms away from the exhaust valve bridge.

2. Remove the exhaust valve bridge (Fig. 2).

3. Place the bridge in a vise or holding fixture J 21772 and loosen the lock nut on the bridge adjusting screw.

> **CAUTION:** Loosening or tightening the lock nut with the bridge in place may result in bending the bridge guide or the rear valve stem.

4. Install the bridge on the bridge guide.

5. While firmly pressing straight down on the pallet surface of the bridge, turn the adjusting screw clockwise until it just touches the valve stem. Then turn the screw an additional 1/8 to 1/4 turn clockwise and tighten the lock nut finger tight.

6. Remove the bridge and place it in a vise. Hold the screw from turning with a screw driver and tighten the lock nut on the adjustment screw. Complete the operation by tightening the lock nut with a torque wrench to 25 lb-ft (34 Nm), being sure that the screw does not turn.

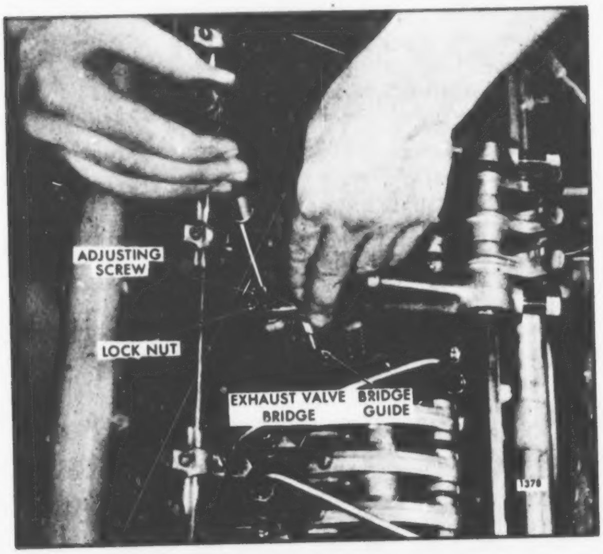


Fig. 2 - Bridge Balancing Adjustment

7. Lubricate the bridge guide and the bridge pilot with engine oil.

8. Reinstall the bridge in its original position.

9. Place a .0015" feeler gage under each end of the bridge. When pressing down on the pallet surface of the bridge, both feeler gages must be tight. If both feeler gages are not tight, readjust the screw as outlined in Steps 5 and 6.

10. Adjust the remaining bridges as outlined above.

11. Swing the rocker arm assembly into position being sure the bridges are properly positioned on the rear valve stems. This precaution is necessary to prevent valve damage due to mislocated bridges.

12. Tighten the rocker arm bracket bolts to 90-100 lb-ft (122-136 Nm) torque.

13. Align the fuel pipes and connect them to the injectors and the fuel connectors. Use socket J 8932 to tighten the connectors to 12-15 lb-ft (16-20 Nm) torque.

> **CAUTION:** Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

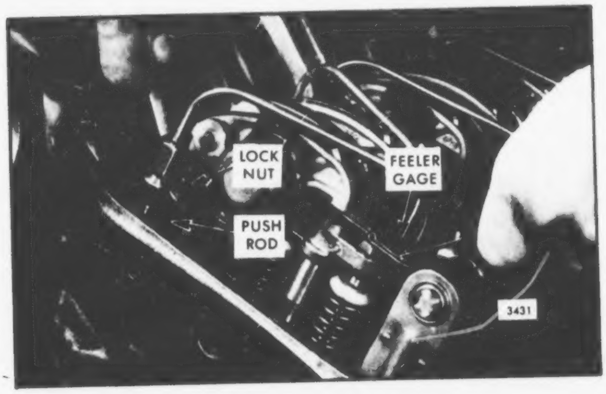


Fig. 3 - Adjusting Valve Clearance

Exhaust Valve Clearance Adjustment (Cold Engine)

All of the exhaust valves may be adjusted, in firing order sequence, during one full revolution of the crankshaft. Refer to the *General Specifications* at the front of the manual for the engine firing order.

1. Place the governor stop lever in the no-fuel position.

2. Clean the loose dirt from the valve rocker covers and remove the covers. Then cover any drain cavities in the cylinder head to prevent foreign material from entering.

> **NOTE:** On certain 12V turbocharged engines, it is necessary to remove the air inlet housing to remove the rocker covers.

3. Rotate the crankshaft, with the starting motor or engine barring tool J 22582, until the injector follower is fully depressed on the cylinder to be adjusted.

> **CAUTION:** If a wrench is used on the crankshaft or camshaft bolt at the front of the engine, do not turn the engine in a left-hand direction of rotation as the bolt will be loosened.

4. Loosen the exhaust valve rocker arm push rod lock nut.

5. Place a .017" feeler gage, J 9708, between the valve bridge and the valve rocker arm pallet (Fig. 3). Adjust the push rod to obtain a smooth "pull" on the feeler gage.

6. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

7. Recheck the clearance. At this time, if the adjustment is correct, the .015" feeler gage will pass freely between the valve bridge and the rocker arm pallet, but the .017" feeler gage will not pass through.

8. Check and adjust the remaining valves in the same manner as outlined above.

Exhaust Valve Clearance Adjustment (Hot Engine)

Maintaining normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance when running at full load may become insufficient.

1. With the engine at normal operating temperature (160-185°F or 71-85°C), recheck the exhaust valve clearance with feeler gage J 9708. At this time, if the valve clearance is correct, the .013" feeler gage will pass freely between the valve bridge and the rocker arm pallet, but the .015" gage will not pass through. Readjust the push rod, if necessary.

2. After the exhaust valve clearance has been adjusted, check the fuel injector timing.

TIMING FUEL INJECTOR

To time an injector properly, the injector follower must be adjusted to a definite height in relation to the injector body.

All of the injectors can be timed, in firing order sequence, during one full revolution of the crankshaft. Refer to the *General Specifications* at the front of the manual for the engine firing order.

Use the proper timing gage as indicated in Table 1.

Time Fuel Injector

After the exhaust valve clearance has been adjusted, time the fuel injectors as follows:

1. Place the speed control lever in the idle speed position. If a stop lever is provided, secure it in the *no-fuel* position.

2. Rotate the crankshaft, by using the starting motor or engine barring tool J 22582, until the exhaust valves are fully depressed on the particular cylinder to be timed.

> **CAUTION:** If a wrench is used on the crankshaft bolt or camshaft nut at the front of the engine, do not turn the engine in a left-hand direction or the bolt or nut will be loosened.

3. Place the small end of the injector timing gage in the hole provided in the top of the injector body, with the flat of the gage toward the injector follower (Fig. 4).

4. Loosen the exhaust valve rocker arm push rod lock nut.

5. Turn the push rod and adjust the injector rocker arm until the extended part of the gage will just pass over the top of the injector follower.

Injector Timing Gage Chart (Needle Valve)

Injector	Timing Dimension	Timing Gage	Camshaft Timing
Generator Sets			
All	1.460"	J 1853	Standard
All Other Applications			
71N5	*1.460"	J 1853	*Standard
N55	*1.460"	J 1853	*Standard
N60	*1.460"	J 1853	*Standard
N65 (white tag)	1.460"	J 1853	Standard
N65 Turbo— (brown tag)	1.484"	J 1242	Standard
N65 (N/A) (brown tag)	**1.484"	J 1242	**Advanced
HN65	1.460"	J 1853	Advanced
N70 Turbo	1.460"	J 1853	Standard
N70 N/A	1.460"	J 1853	Advanced
N75 N/A	1.484"	J 1242	Advanced
N75 Turbo	1.460"	J 1853	Standard
N80 Turbo	1.484"	J 1242	Standard
N80 N/A	**1.484"	J 1242	**Advanced
N90	1.460"	J 1853	Standard

N/A—Naturally aspirated engines.

*Use 1.484" timing gage (J1242) when engine has advanced camshaft timing. Correct to standard camshaft timing and 1.460" injector timing at first opportunity to be consistent with current production build.

**Use 1.460" timing gage (J 1853) when engine has standard camshaft timing. Correct to advanced camshaft timing and 1.484" injector timing at first opportunity.

NOTE: Advanced camshaft timing is indicated by "ADV-CAM-TIMING" stamped on lower right hand side of option plate.

TABLE 1

6. Hold the push rod and tighten the lock nut. Check the adjustment and, if necessary, readjust the push rod.

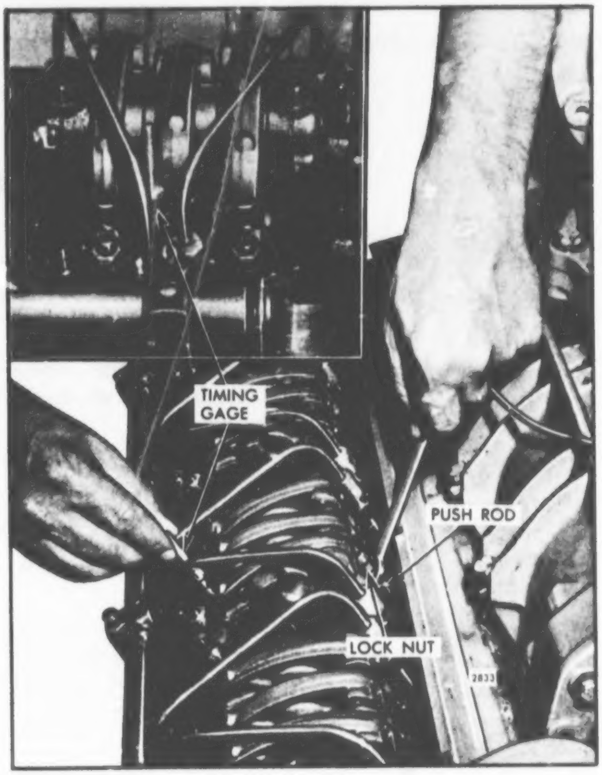


Fig. 4 - Timing Fuel Injector

7. Time the remaining injectors in the same manner as outlined above.

8. If no further engine tune-up is required, use new gaskets and install the valve rocker covers.

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6, 8 and 12V-71 ENGINES

The two types of limiting speed mechanical governors used on the V-71 engines are covered in this procedure. The difference between each type of governor is in the high speed spring retainer and spring housing assembly. Industrial engines use the standard limiting speed governor, while some applications may find it advantageous to use the dual-range limiting speed governor.

The only variation in the tune-up procedure between each type of governor is in the setting of the maximum no-load speed. Therefore, the setting of the maximum no-load engine speed is given for each type of limiting speed governor.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and position the injector rack control levers.

> **NOTE:** Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, reconnect and adjust the supplementary governing device.

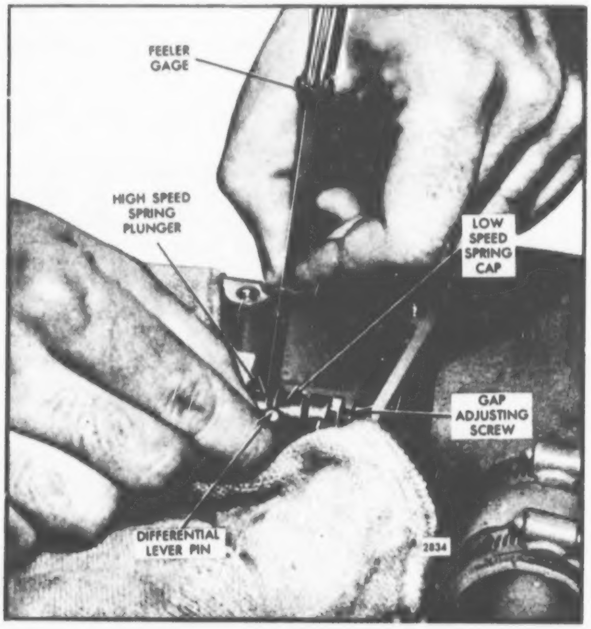


Fig. 1 - Adjusting Governor Gap

Adjust the Governor Gap

With the engine stopped and at normal operating temperature, adjust the governor gap as follows:

1. Remove the two bolts and withdraw the governor high speed spring retainer cover.

2. Back out the buffer screw until it extends approximately 5/8" from the lock nut (Fig. 10).

3. Start the engine and loosen the idle speed adjusting screw lock nut. Then adjust the idle screw (Fig. 9) to obtain the desired engine idle speed. Hold the screw and tighten the lock nut to hold the adjustment.

> **IMPORTANT:** Current turbocharged engines include a starting aid screw threaded into the governor housing.

> **NOTE:** The recommended idle speed for non-EPA certified engines is 400-450 rpm, but may vary with special engine application.

4. Stop the engine. Clean and remove the governor cover and lever assembly and discard the gasket.

5. Start and run the engine between 800 and 1000 rpm by manual operation of the differential lever.

> **CAUTION:** Do not overspeed the engine.

6. Check the gap between the low speed spring cap and the high speed spring plunger (Fig. 1) with a .0015" feeler gage. If the gap setting is incorrect, reset the gap adjusting screw.

If the setting is correct, the .0015" movement can be seen by placing a few drops of oil into the governor gap and pressing a screw driver against the gap adjusting screw. Movement of the cap toward the plunger will force the oil from the gap in the form of a small bead.

7. Hold the gap adjusting screw and tighten the lock nut.

8. Recheck the governor gap and readjust if necessary.

9. Stop the engine and, using a new gasket, install the governor cover and lever assembly. Tighten the screws.

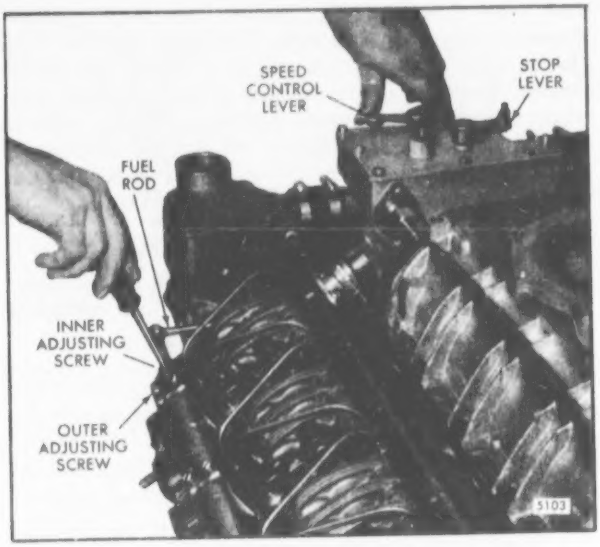


Fig. 2 - Positioning No. 1 Injector Rack Control Lever (Two Screw Assembly)

Position Injector Rack Control Levers

The position of the injector rack must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Certain engines use spring-loaded injector control tube assemblies which have a yield spring at each injector rack control lever and only one screw and lock nut to keep each injector rack properly positioned. Adjust the single screw and lock nut on each injector rack control lever the same as for the two screw rack control lever.

Properly positioned injector rack control levers with the engine at full load will result in the following:

1. Speed control lever at the maximum speed position.

2. Governor low speed gap closed.

3. High speed spring plunger on the seat in the governor control housing.

4. Injector fuel control racks in the full-fuel position.

The letters R and L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. The cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the No. 1L injector rack control lever first to establish a guide for adjusting the remaining injector rack control levers.

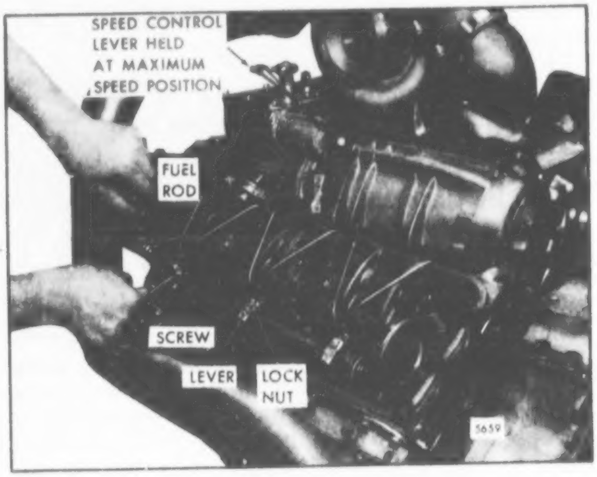


Fig. 3 - Positioning No. 1 Injector Rack Control Lever (One Screw and Lock Nut Assembly)

1. Disconnect any linkage attached to the governor speed control lever.

2. Turn the idle speed adjusting screw until 1/2" of the threads (12-14 threads) project from the lock nut when the nut is against the high speed plunger.

> **CAUTION:** A false fuel rack setting may result if the idle speed adjusting screw is not backed out as noted above.

> **NOTE:** This adjustment lowers the tension on the low speed spring so it can be easily compressed. This permits closing the low speed gap without bending the fuel rods or causing the *yield mechanism springs to yield or stretch.*

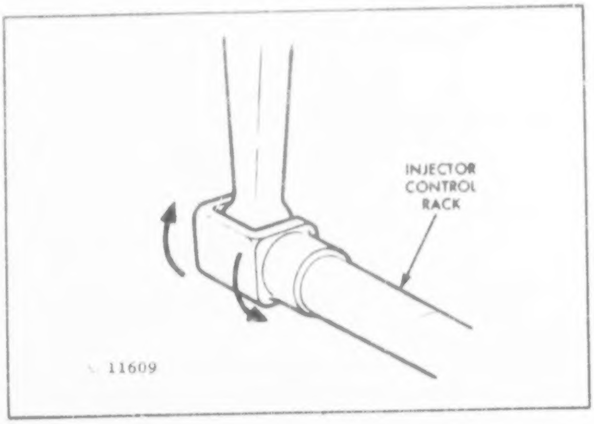


Fig. 4 - Checking Rotating Movement of Injector Control Rack

3. Back out the buffer screw approximately 5/8", if it has not already been done.

4. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.

5. Loosen all of the inner and outer injector rack control lever adjusting screws on both cylinder heads. Be sure all of the injector rack control levers are free on the injector control tubes.

6. Move the governor speed control lever to the maximum speed position; hold it in that position with a light finger pressure. Turn the inner adjusting screw of the No. 1L injector rack control lever down until a slight movement in the control lever is observed or a step-up in effort to turn the screw driver is noted (refer to Fig. 2 or 3). This will place the No. 1L injector rack in the full-fuel position. Turn down the outer adjusting screw until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

> **IMPORTANT:** The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full load.

7. To be sure of the proper rack adjustment, hold the speed control lever in the maximum speed position and press down on the injector rack with a screw driver or finger tip and note "rotating" movement of the injector control rack (Fig. 4). Hold the speed control lever in the maximum speed position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 5) and when the pressure of the screw driver is released, the control rack should "spring" back upward.

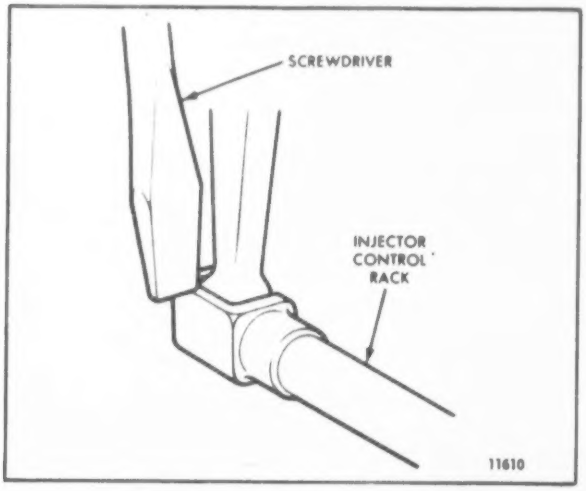


Fig. 5 - Checking Injector Control Rack "Spring"

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

The setting is too tight if, when moving the speed control lever from the no-speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

8. Remove the clevis pin from the fuel rod and the left-bank injector control tube.

9. Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the 1R injector rack control lever as previously outlined in Step 6 for the 1L injector rack control lever.

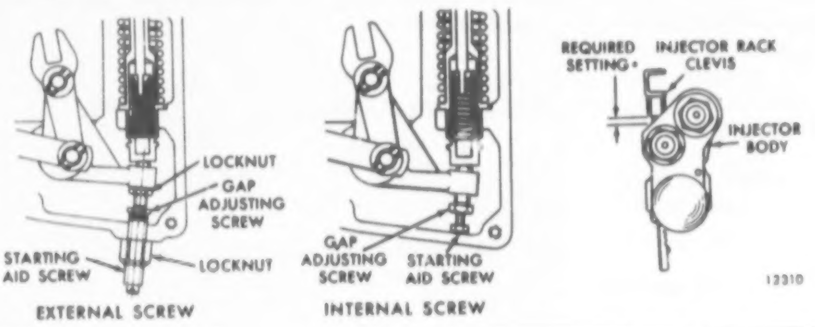
10. Insert the clevis pin in the fuel rod and the left bank injector control tube lever. Repeat the check on the 1L and 1R injector rack control levers as outlined in Step 7. Check for and eliminate any deflection which occurs at the bend in the fuel rod where it enters the cylinder head.

11. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rods and the injector control tube levers, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube and proceed as follows:

a. Turn down the inner adjusting screw of the injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

b. Turn down the outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

c. While still holding the control tube lever in the fuel-fuel position, adjust the inner and outer adjusting screws to obtain the same condition as outlined in Step 7. Tighten the screws.



INJECTOR	GAGE SETTING •	TOOL NUMBER
S 80	.345"	J 24889
N 60	.345"	J 24889
N 65	.385"	J 24882
N 70	.385"	J 24882
N 75	.385"	J 24882
N 80	.385"	J 24882
N 90	.454"	J 23190
C 65	.385"	J 24882
C 80	.385"	J 24882
M 70	.385"	J 24882
M 95	.454"	J 23190

Fig. 6 - Starting Aid Screw Adjustment

CAUTION: Once the No. 1L and No. 1R injector rack control levers are adjusted, do not try to alter their settings. All adjustments are made on the remaining control racks.

NOTE: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lb**(3-4 Nm).

12. When all of the injector rack control levers are adjusted, recheck their settings. With the control tube lever in the full-fuel position, check each control rack as in Step 7. All of the control racks must have the same "spring" condition with the control tube lever in the full-fuel position.

13. Insert the clevis pin in the fuel rod and the injector control tube levers.

14. Turn the idle speed adjusting screw in until it projects 3/16" from the lock nut, to permit starting the engine.

15. Use new gaskets and replace the valve rocker covers.

Adjust Starting Aid Screw - Turbocharged Engines

The starting aid screw (Fig. 6) is threaded into the governor housing of current engines and into the governor gap adjusting screw of early engines. This screw is adjusted to position the injector racks at less than full fuel when the governor speed control lever is in the idle position. The reduced fuel makes starting easier and reduces the amount of smoke on start-up.

IMPORTANT: The effectiveness of the starting aid screw will be eliminated if the speed control lever is advanced to wide open throttle during starting.

After the normal governor *running* gap of .0015" has been set and the injector racks positioned, adjust the starting aid screw.

1. On current turbocharged engines, adjust the external starting aid screw as follows:

a. With the engine *stopped*, place the governor stop lever in the *run* position and the speed control lever in the *idle speed* position.

b. Adjust the starting aid screw to obtain the required setting between the shoulder on the injector rack clevis and the injector body (Fig. 6). Select the proper gage and measure the setting at any convenient cylinder. When the starting aid screw is properly adjusted, the gage should have a small clearance of 1/64" (.397 mm) in the space along the injector rack shaft between the rack clevis and the injector body.

c. After completing the adjustment, hold the starting aid screw and tighten the lock nut.

d. Check the injector rack clevis-to-body clearance after performing the following:

1. Position the stop lever in the *run* position.
2. Move the speed control lever from the *idle speed* position to the *maximum speed* position.
3. Return the speed control lever to the *idle speed* position.

PART NAME	GROUP NO.
CUT OUT ASSY., GENERATOR VOLTAGE REGULATOR	7.1607 A
CUTOUT ASSY., GENERATOR ASSY. VOLTAGE REGULATOR	7.1607 A
CUTOUT ASSY., GENERATOR ASSY., VOLTAGE REGULATOR	7.1607 A
CUTOUT ASSY., GENERATOR VOLTAGE REGULATOR	7.1607 A
CYLINDER ASSY., FAST IDLE AIR	2.7850 A
CYLINDER ASSY., MASTER REMOTE CONTROL	12.6808 E
CYLINDER ASSY., THROTTLE CONTROL AIR	2.9860 A
CYLINDER KIT	1.6182

D

PART NAME	GROUP NO.
DAMPER, CRANKSHAFT FRONT GEAR	1.3147
DAMPER, VIBRATION	1.3210 B
DEFLECTOR, INJECTOR SPILL	2.1050 A
DEFLECTOR, ROTOR ASSY. SHAFT OIL	3.5029 A
DIAPHRAGM, OVERSPEED VALVE PISTON	7.4733 C
DIAPHRAM, OVERSPEED VALVE PISTON	7.4733 C
DIFFUSER, TURBOCHARGER AIR	3.5024 A
DIPSTICK	4.6001 A
DIPSTICK, (TORQUE CONVERTER)	8.3840 B
DIPSTICK, GEAR BOX	9.3420 A
DIPSTICK, REDUCTION GEAR	8.1960 A
DIPSTICK, REDUCTION GEAR	9.1395 A
DIPSTICK, TORQUE CONVERTER OIL TANK	11.1245 A
DIPSTICK, TORQUE CONVERTER OIL TANK	11.1245 A
DISC, BLOWER ROTOR FUEL PUMP	3.4110
DISC, FLYWHEEL FLEXIBLE COUPLING	1.4075 A
DISC, FUEL PUMP DRIVE	2.2228
DISC, HYDRAULIC STARTER ACCUMULATOR PRESSURE RELIEF	12.6584 D
DISC, THERMO FAN CLUTCH	5.4370 A
DOWELLED PARTS ASSEMBLY, HYDRAULIC PUMP	9.1484 A
DRAIN ASSY., RADIATOR	5.3395 B
DRAINCOCK, FUEL FILTER	2.3500 A
DRAINCOCK, INTERCOOLER WATER	3.5435 A
DRIVE ASSY., ACCESSORY	1.7600 B
DRIVE ASSY., GENERATOR	7.1507 A
DRIVE ASSY., GOVERNOR	2.6750 A
DRIVE ASSY., HYDRAULIC PUMP	12.5006 A
DRIVE ASSY., STARTER (BENDIX)	12.6040 A
DRIVE GEAR & SHAFT ASSY., TACHOMETER DRIVE CABLE ADAPTOR	7.4423 B
DRIVE UNIT, TACHOMETER	7.4062 A
DRIVE, ASSY., GENERATOR	7.1507 A
DRIVE, HYDRAULIC STARTER ENGINE PUMP	12.6594 D

E

PART NAME	GROUP NO.
ELBOW, CYLINDER HEAD FRESH WATER OUTLET	5.3443 B
ELBOW, CYLINDER HEAD FRESH WATER OUTLET	5.3443 B
ELBOW, EXHAUST MANIFOLD FRESH WATER OUTLET	5.3440 B
ELBOW, OIL COOLER WATER (OUTLET-INLET)	4.4220 A
ELBOW, OIL COOLER WATER OUTLET-INLET	4.4220 A
ELBOW, OIL COOLER WATER OUTLET-INLET	4.4220 A
ELBOW, RAW WATER PUMP INLET	5.6573 A
ELBOW, THERMOSTAT HOUSING COVER OUTLET	5.2122 B
ELBOW, TURBOCHARGER AIR INLET	3.5400 A
ELBOW, TURBOCHARGER AIR OUTLET	3.5417 A
ELBOW, WATER MANIFOLD OUTLET	5.2210 C
ELBOW, WATER OUTLET MANIFOLD	5.2035 A
ELECTRODE, HEAT EXCHANGE	5.5010 A
ELECTRODE, HEAT EXCHANGER	5.5010 A
ELECTRODE, RAW WATER PUMP	5.6575 A
ELEMENT, AIR CLEANER	3.1050 A
ELEMENT, AIR SILENCER	3.2002 A
ELEMENT, CONVERTER OIL FILTER	8.3872 B
ELEMENT, DRAIN TANK	1.1180 A
ELEMENT, FUEL FILTER	2.3320 A
ELEMENT, FUEL STRAINER (PRIMARY)	2.3010 A
ELEMENT, HYDRAULIC STARTER FILTER	12.6805 E
ELEMENT, INJECTOR FILTER	2.1110 A
ELEMENT, OIL FILTER	2.8986 A
ELEMENT, OIL FILTER	4.2250 A
ELEMENT, OIL FILTER	8.1575 A
ELEMENT, OIL FILTER	9.1780 A
ELEMENT, OIL STRAINER	9.1655 A
ELEMENT, THERMO FAN CONTROL	5.4372 A
ELEMENT, WATER FILTER	5.7020 A
ENCLOSURE ASSY., AUTOMATIC STARTING CABINET	7.2203 B
EYE, THROTTLE BOOSTER ADJUSTING	2.9348 A

F

PART NAME	GROUP NO.
FACING, CLUTCH	8.1030 A
FACING, CLUTCH	9.1030 B
FAN ASSY.	5.4001 A
FAN, GENERATOR	7.1440 A
FERRULE AND NUT, FLEXIBLE SHAFT CASING	12.8514 B
FILTER ASSEMBLY	4.2240 A
FILTER ASSY.	4.2240 A
FILTER ASSY., CONVERTER OIL	8.3870 B
FILTER ASSY., FUEL	2.3310 A
FILTER ASSY., HYDRAULIC STARTER	12.6801 E
FILTER ASSY., MARINE GEAR OIL	4.4365 A
FILTER ASSY., MARINE GEAR OIL FILTER	4.4365 A
FILTER ASSY., OIL	2.8985 A
FILTER ASSY., OIL	9.1778 A
FILTER ASSY., POWER TAKE-OFF (FULL FLOW)	8.1574 A
FILTER ASSY., POWER TAKE-OFF (FULL FLOW)	8.1574 A
FILTER ASSY., WATER	5.7001 A
FILTER UNIT, BREATHER OIL SEPARATOR	4.8060 A
FILTER, AIR HEATER	7.8060 A
FILTER, GENERATOR REGULATOR SHIELD. (RADIO INTERFERENCE)	7.1800 A
FILTER, HYDRAULIC STARTER RESERVOIR	12.6558 D
FILTER, OIL	4.2240 A

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PART NAME GROUP NO.

FITTING, CLUTCH DRIVE SHAFT BEARING GREASE . . . 8.1685 A
FITTING, CLUTCH PILOT BEARING GREASE . . . 8.1455 A
FITTINGS KIT, HYDRAULIC STARTER . . . 12.6825 E
FITTINGS, FLEXIBLE (BULK) END . . . 12.8552 B
FLANGE, & SEAL ASSY., OVERSPEED VALVE CABLE ADAPTOR . . . 7.4588 C
FLANGE, EXHAUST . . . 6.2085 A
FLANGE, EXHAUST MANIFOLD WATER OUTLET . . . 6.1140 A
FLANGE, OIL COOLER BY-PASS TUBE . . . 4.4177 A
FLANGE, OIL COOLER WATER OUTLET . . . 4.4242 A
FLANGE, OIL COOLER WATER OUTLET FLANGE . . . 4.4242 A
FLANGE, PROPELLER DRIVE . . . 9.1430 A
FLANGE, PROPELLER DRIVE SHAFT COUPLING . . . 9.3450 A
FLANGE, THERMO FAN DRIVE . . . 5.4368 A
FLYWHEEL AND FORWARD CLUTCH KIT . . . 9.1203 A
FLYWHEEL ASSY. . . . 1.4001 A
FLYWHEEL ASSY., REVERSE GEAR . . . 9.1200 A
FOLLOWER ASSY., AUTOMATIC STARTING CONTACT SPRING & CAM . . . 7.2290 B
FOLLOWER ASSY., CAM . . . 1.8260
FOLLOWER, INJECTOR . . . 2.1060 A
FORK, FUEL PUMP COUPLING . . . 2.2220
FORK, GOV. OPERATING SHAFT . . . 2.7290 A
FORK, GOVERNOR OPERATING . . . 8.3430 A
FORK, GOVERNOR OPERATING SHAFT . . . 2.7290 A
FORK, GOVERNOR SPEED ADJUSTING LINKAGE SPRING . . . 2.8435 A
FORK, HYDRAULIC STARTER CLUTCH . . . 12.6509 D
FUSE, ENGINE WIRING HARNESS . . . 7.7005 A

G

GAGE, AIR HEATER PRESSURE . . . 7.8342 A
GAGE, AIR PRESSURE . . . 7.4024 A
GAGE, FUEL PRESSURE . . . 7.4091 A
GAGE, HYDRAULIC STARTER PRESSURE . . . 12.6586 D
GAGE, OIL PRESSURE (ENGINE) . . . 7.4070 A
GAGE, OIL PRESSURE (REVERSE GEAR OR TORQUE CONVERTER) . . . 7.4071 A
GAGE, OIL PRESSURE (REVERSE GEAR OR TORQUE CONVETER) . . . 7.4071 A
GAGE, OIL PRESSURE (REVERSE GEAR OR TORQUE CONVERTER) . . . 7.4071 A
GAGE, OIL PRESSURE (REVERSE GEAR) . . . 7.4071 A
GAGE, OIL TEMPERATURE . . . 7.4077 A
GAGE, WATER TEMPERATURE . . . 7.4080 A
GASKET KIT, BLOWER INSTALLATION . . . 3.4003
GASKET KIT, CYLINDER HEAD OVERHAUL . . . 1.2002
GASKET KIT, ENGINE OVERHAUL . . . 1.1002
GASKET KIT, HYDRAULIC MARINE GEAR OVERHAUL . . . 9.1017 A
GASKET SET, BILGE PUMP BODY . . . 12.2030 A
GASKET SET, CYLINDER HEAD OIL . . . 1.2020
GASKET, ACCESSORY DRIVE . . . 1.7604 B
GASKET, ACCESSORY DRIVE ADAPTOR . . . 1.7623 B
GASKET, ACCESSORY DRIVE HOLE COVER . . . 1.7500 A
GASKET, ACCESSORY DRIVE RETAINER . . . 1.7646 B
GASKET, AIR BOOSTER INLET ELBOW TO AIR COMPRESSOR . . . 12.4380 A
GASKET, AIR BOOSTER INLET TUBE ELBOW TO AIR COMPRESSOR . . . 12.4380 A
GASKET, AIR CLEANER INLET HOUSING PIPE . . . 3.1261 A
GASKET, AIR CLEANER MOUNTING ADAPTOR . . . 3.1087 A
GASKET, AIR CLEANER SCREEN . . . 3.1055 A
GASKET, AIR CLEANER TO INLET HOUSING PIPE . . . 3.1261 A
GASKET, AIR COMP. ADAPTOR . . . 12.4025 A
GASKET, AIR COMP. MOUNTING . . . 12.4005 A
GASKET, AIR COMPRESSOR . . . 12.4025 A
GASKET, AIR COMPRESSOR ADAPTOR . . . 12.4025 A
GASKET, AIR COMPRESSOR MOUNTING . . . 12.4005 A
GASKET, AIR HEATER . . . 7.8020 A
GASKET, AIR HEATER CAP . . . 7.8076 A
GASKET, AIR HEATER INSULATOR . . . 7.8140 A
GASKET, AIR INLET HOUSING . . . 3.3010 A
GASKET, AIR INLET HOUSING STRIKER PLATE . . . 3.3030 A
GASKET, AIR INLET MANIFOLD . . . 3.3311 A
GASKET, AIR STARTER MOUNTING . . . 12.6085 B
GASKET, BALANCE WEIGHT COVER . . . 1.7480 A
GASKET, BLOWER . . . 3.4010
GASKET, BLOWER DRIVE GEAR HUB SUPPORT . . . 3.4360
GASKET, BLOWER END PLATE HOUSING COVER . . . 3.4150
GASKET, BREATHER BODY . . . 4.8070 A
GASKET, BREATHER OIL SEPARATOR . . . 4.8070 A
GASKET, BREATHER PIPE . . . 4.8020 A
GASKET, BREATHER SEPARATOR . . . 4.8070 A
GASKET, CAMSHAFT FRONT END BEARING . . . 1.7012
GASKET, CLUTCH HOUSING INSPECTION HOLE COVER . . . 8.1070 A
GASKET, CONTROL VALVE SHUT-OFF LOCK SCREW . . . 9.1174 A
GASKET, CONVERTER OIL FILTER COVER SCREW . . . 8.3877 B
GASKET, CONVERTER OIL FILTER SHELL . . . 8.3875 B
GASKET, CONVERTER PRESSURE PUMP . . . 8.3610 A
GASKET, COOLER BY-PASS HOLE COVER . . . 4.4184 A
GASKET, CRANKSHAFT FRONT COVER . . . 1.3170 A
GASKET, CRANKSHAFT FRONT COVER LARGE HOLE COVER . . . 1.3198 A
GASKET, CRANKSHAFT FRONT COVER SMALL HOLE COVER . . . 1.3196 A
GASKET, CYLINDER BLOCK END PLATE (FRONT) . . . 1.1030
GASKET, CYLINDER BLOCK END PLATE (REAR) . . . 1.1032
GASKET, CYLINDER BLOCK END PLATE (FRONT) . . . 1.1030
GASKET, CYLINDER BLOCK END PLATE (REAR) . . . 1.1032
GASKET, CYLINDER BLOCK HAND HOLE COVER . . . 1.1050
GASKET, CYLINDER BLOCK OIL HOLE COVER . . . 1.1066
GASKET, CYLINDER BLOCK WATER HOLE COVER . . . 1.1070
GASKET, CYLINDER HEAD COMPRESSION . . . 1.2010

PART NAME GROUP NO.

GASKET, CYLINDER HEAD GOVERNOR HOLE COVER 1.2060
GASKET, CYLINDER HEAD WATER AND OIL . . 1.2022
GASKET, DRAIN TANK BASE RING. . . . . . 1.1210 A
GASKET, DRAIN TANK RETAINER BOTTOM. . . 1.1230 A
GASKET, DRIVE TO GOVERNOR . . . . 2.8760 A
GASKET, ENGINE LIFTER BRACKET . . . . . 1.2090 A
GASKET, EXHAUST MANIFOLD. . . . . 6.1010 A
GASKET, EXHAUST MANIFOLD COVER PLATE . . . . 6.1110 A
GASKET, EXHAUST MANIFOLD COVER PLATE. . 6.1110 A
GASKET, EXHAUST MANIFOLD FRESH WATER OUTLET ELBOW. . . . . 5.3341 B
GASKET, EXHAUST MANIFOLD FRESH WATER OUTLET ELBOW. . . . . 5.3441 B
GASKET, EXHAUST MANIFOLD WATER OUTLET FLANGE . . . . 6.1150 A
GASKET, EXHAUST MANIFOLD WATER OUTLET FLANGE . . . . 6.1150 A
GASKET, EXHAUST OUTLET. . . . . 6.2105 A
GASKET, EXHAUST PIPE ADAPTOR. . . . . . 6.1195 A
GASKET, EXPANSION TANK COVER. . . . . . 5.5021 A
GASKET, EXPANSION TANK FILLER NECK. . . 5.5130 A
GASKET, EXPANSION TANK OUTLET CONNECTION. . . . . 5.3321 B
GASKET, FLYWHEEL HOUSING. . . . . 1.5010 A
GASKET, FLYWHEEL HOUSING ADAPTOR. . . . 1.5035 A
GASKET, FLYWHEEL HOUSING BELL . . . . . 1.5020 A
GASKET, FLYWHEEL HOUSING INSPECTION HOLE COVER. . . . . 1.5090 A
GASKET, FLYWHEEL HOUSING LARGE HOLE COVER . . . . 1.5040 A
GASKET, FLYWHEEL HOUSING SMALL HOLE COVER . . . . 1.5060 A
GASKET, FORWARD CLUTCH DUMP VALVE SPRING COVER. . . . . 9.1280 A
GASKET, FRESH WATER OUTLET ELBOW. . . . 5.3444 B
GASKET, FRESH WATER PUMP. 5.1010
GASKET, FRESH WATER PUMP BEARING SUPPORT 5.1074
GASKET, FRESH WATER PUMP BODY COVER . . 5.1032
GASKET, FUEL FILTER COVER SCREW . . . . 2.3420 A
GASKET, FUEL FILTER COVER SHELL . . . . 2.3400 A
GASKET, FUEL PUMP TO ENGINE 2.2007
GASKET, FUEL PUMP VALVE PLUG. 2.2180
GASKET, FUEL STRAINER COVER . . . . . . 2.3090 A
GASKET, FUEL STRAINER COVER PLUG. . . . 2.3110 A
GASKET, FUEL STRAINER COVER SCREW . . . 2.3130 A
GASKET, FUEL STRAINER ELEMENT TOP . . . 2.3020 A
GASKET, FUEL TANK CAP . . . . 2.6035 A
GASKET, GEAR BOX BREATHER AND FILLER. . 9.3290 A
GASKET, GEAR BOX HOUSING COVER. . . . . 9.3270 A
GASKET, GEAR BOX OUTPUT SHAFT BEARING COVER . . . . 9.3096 A
GASKET, GEAR BOX OUTPUT SHAFT BEARING HOUSING . . . . 9.3047 A
GASKET, GEAR BOX OUTPUT SHAFT OIL SEAL RETAINER . . . . 9.3140 A
GASKET, GENERATOR DRIVE BEARING & OIL SEAL RETAINER . . . . 7.1525 A
GASKET, GENERATOR DRIVE BEARING AND OIL SEAL RETAINER . . . . 7.1525 A
GASKET, GENERATOR MOUNTING BRACKET. . . 7.1597 A

PART NAME GROUP NO.

GASKET, GOVERNOR BODY TO BASE . . . . . 8.3390 A
GASKET, GOVERNOR CONTROL LINK HOUSING . . . . 2.7854 A
GASKET, GOVERNOR CONTROL LINK HOUSING COVER . . . . 2.7900 A
GASKET, GOVERNOR COVER. . . . . 2.7051 A
GASKET, GOVERNOR COVER. . . . . 2.8045 A
GASKET, GOVERNOR DRIVE TACHOMETER DRIVE ADAPTOR . . . . 2.8535 A
GASKET, GOVERNOR FUEL ROD SPRING COVER . . . . 2.8086 A
GASKET, GOVERNOR HIGH SPEED-SPRING COVER . . . . 2.7650 A
GASKET, GOVERNOR HOUSING DUMMY HOLE PLUG. . . . . 2.8210 A
GASKET, GOVERNOR RELIEF VALVE . . . . . 2.8640 A
GASKET, GOVERNOR SPEED ADJUSTING SHAFT . . . . 2.8363 A
GASKET, GOVERNOR SPEED ADJUSTING SHAFT SPACER CAP. . . . . 2.8367 A
GASKET, GOVERNOR SUB-CAP TO HOUSING . . 2.8260 A
GASKET, GOVERNOR TO BLOWER. . . . . . . 2.7010 A
GASKET, GOVERNOR TO BLOWER. . . . . . . 2.8035 A
GASKET, GOVERNOR VARIABLE SPEED SPRING HOUSING. . . . . 2.7700 A
GASKET, GOVERNOR WEIGHT HOUSING CAP . . 2.7515 A
GASKET, HEAT EXCHANGER. . . . . 5.5050 A
GASKET, HEAT EXCHANGER OUTLET CONNECTION. . . . . 5.3325 B
GASKET, HEAT EXCHANGER TANK INLET CONNECTION. . . . . 5.3323 B
GASKET, HEAT EXCHANGER TANK OUTLET CONNECTION. . . . . 5.3325 B
GASKET, HEAT EXCHANGER WATER MANIFOLD. . . . . 5.2128 B
GASKET, HEAT EXCHANGER WATER INLET TUBE. . . . . 5.5460 A
GASKET, HEAT EXCHANGER WATER OUTLET TUBE. . . . . 5.5570 A
GASKET, HYDRAULIC CONTROL VALVE COVER . . . . 9.1179 A
GASKET, HYDRAULIC MARINE GEAR OIL PUMP ADAPTOR. . . . . 9.1478 A
GASKET, HYDRAULIC MARINE GEAR OIL PUMP. . . . . 9.1480 A
GASKET, HYDRAULIC MARINE GEAR OIL PUMP ADAPTOR. . . . . 9.1478 A
GASKET, HYDRAULIC PUMP. . . . . 9.1455 A
GASKET, HYDRAULIC PUMP. . . . . 12.5005 A
GASKET, HYDRAULIC PUMP ADAPTOR. . . . . 12.5021 A
GASKET, HYDRAULIC PUMP VALVE SCREW. . . 9.1535 A
GASKET, HYDRAULIC STARTER . . . . 12.6502 D
GASKET, HYDRAULIC STARTER ENGINE PUMP. . . . . 12.6592 D
GASKET, HYDRAULIC STARTER ENGINE PUMP BODY . . . . 12.6558 D
GASKET, HYDRAULIC STARTER ENGINE PUMP . . . . 12.6592 D
GASKET, HYDRAULIC STARTER MOTOR HOUSING . . . . 12.6530 D
GASKET, INJECTOR FILTER CAP . . . . . . 2.1140 A
GASKET, LOWER OIL PAN . . . . 4.7040 A
GASKET, MARINE GEAR OIL PUMP. . . . . . 9.1480 A

PART NAME GROUP NO.

GASKET, MARINE GEAR OIL PUMP PUMP . . . 9.1480 A
GASKET, MASTER CYLINDER RESERVOIR COVER . . . 12.6813 E
GASKET, OIL COOLER ADAPTOR COVER . . . 4.4117 A
GASKET, OIL COOLER ADAPTOR TO BLOCK . . . 4.4115 A
GASKET, OIL COOLER BY-PASS HOLE COVER . . . 4.4184 A
GASKET, OIL COOLER BY-PASS TUBE FLANGE . . . 4.4178 A
GASKET, OIL COOLER BY-PASS VALVE PLUG . . . 4.4170 A
GASKET, OIL COOLER BY-PASS VALVE P LUG . . . 4.4170 A
GASKET, OIL COOLER CORE INNER . . . 4.4030 A
GASKET, OIL COOLER CORE OUTER . . . 4.4040 A
GASKET, OIL COOLER COVER . . . 4.4061 A
GASKET, OIL COOLER COVER BRACKET . . . 4.4064 A
GASKET, OIL COOLER HOUSING COVER . . . 4.4061 A
GASKET, OIL COOLER INLET AND OUTLET TUBE . . . 4.4200 A
GASKET, OIL COOLER WATER ELBOW . . . 4.4230 A
GASKET, OIL COOLER WATER INLET CONNECTION . . . 4.4212 A
GASKET, OIL COOLER WATER OUTLET FLANGE . . . 4.4244 A
GASKET, OIL FILLER ADAPTOR . . . 4.5007 A
GASKET, OIL FILLER CAP . . . 4.5015 A
GASKET, OIL FILLER TUBE . . . 4.5050 A
GASKET, OIL FILTER ADAPTOR . . . 4.2350 A
GASKET, OIL FILTER ADAPTOR TO OIL COOLER . . . 4.2293 A
GASKET, OIL FILTER BY-PASS . . . 9.1799 A
GASKET, OIL FILTER BY-PASS HOUSING . . . 4.2389 A
GASKET, OIL FILTER BY-PASS PLUG . . . 4.2489 A
GASKET, OIL FILTER BY-PASS PLUG . . . 8.1986 A
GASKET, OIL FILTER BY-PASS VALVE PLUG . . . 4.2489 A
GASKET, OIL FILTER COVER . . . 4.2300 A
GASKET, OIL FILTER COVER . . . 8.1978 A
GASKET, OIL FILTER COVER . . . 9.1785 A
GASKET, OIL FILTER COVER NUT . . . 4.2330 A
GASKET, OIL FILTER COVER NUT . . . 8.1981 A
GASKET, OIL FILTER COVER NUT . . . 9.1788 A
GASKET, OIL FILTER ELEMENT . . . 2.8987 A
GASKET, OIL FILTER PRESSURE REGULATOR PLUG . . . 8.3890 B
GASKET, OIL FILTER RETURN HOLE COVER . . . 4.4084 A
GASKET, OIL FILTER TUBE ADAPTOR . . . 4.3027 A
GASKET, OIL LINE FLANGE COVER . . . 9.1187 A
GASKET, OIL PAN COVER . . . 4.7130 A
GASKET, OIL PAN DRAIN PLUG . . . 4.7090 A
GASKET, OIL PAN SUMP . . . 4.7150 A
GASKET, OIL PAN TO BLOCK . . . 4.7030 A
GASKET, OIL PRESSURE REGULATOR BODY . . . 4.1730 C
GASKET, OIL PUMP . . . 4.1232 A
GASKET, OIL PUMP COVER . . . 4.1230 A
GASKET, OIL PUMP COVER FLANGE . . . 4.1232 A
GASKET, OIL PUMP INLET PIPE . . . 4.1520 B
GASKET, OIL PUMP OUTLET PIPE . . . 4.1590 B
GASKET, OIL PUMP PAD COVER . . . 4.1300 A
GASKET, OIL PUMP RELIEF VALVE . . . 4.1280 A
GASKET, OIL PUMP TO CYLINDER BLOCK . . . 4.1307 A

PART NAME GROUP NO.

GASKET, OIL STRAINER COVER . . . 9.1660 A
GASKET, OIL TANK HAND HOLE COVER . . . 8.3850 B
GASKET, OIL TANK HAND HOLE COVER . . . 11.1261 A
GASKET, OVERSPEED AND LOW OIL PRESSURE VALVE . . . 7.4552 C
GASKET, OVERSPEED TRIP GOVERNOR . . . 7.4638 C
GASKET, OVERSPEED TRIP GOVERNOR ADAPTOR . . . 7.4638 C
GASKET, POWER TAKE-OFF ADAPTOR HOUSING . . . 8.1901 A
GASKET, POWER TAKE-OFF ADAPTOR HOUSING OIL . . . 8.1901 A
GASKET, RADIATOR FILLER CAP . . . 5.3130 A
GASKET, RADIATOR FILLER NECK . . . 5.3110 A
GASKET, RADIATOR INLET CONNECTION . . . 5.3280 B
GASKET, RADIATOR OUTLET CONNECTION . . . 5.3320 B
GASKET, RADIATOR TANK . . . 5.3040 A
GASKET, RAW WATER PUMP . . . 5.6350 A
GASKET, RAW WATER PUMP ADAPTOR . . . 5.6012 A
GASKET, RAW WATER PUMP COVER . . . 5.6100 A
GASKET, RAW WATER PUMP INLET ELBOW . . . 5.6574 A
GASKET, RAW WATER PUMP OUTLET TUBE . . . 5.6581 A
GASKET, REDUCTION GEAR BEARING COVER . . . 9.1370 A
GASKET, REDUCTION GEAR COVER PLATE . . . 8.1926 A
GASKET, REDUCTION GEAR DIPSTICK . . . 9.1405 A
GASKET, REDUCTION GEAR HOUSING . . . 8.1922 A
GASKET, REDUCTION GEAR OIL SUMP . . . 9.1390 A
GASKET, REVERSE GEAR DRIVE SHAFT BEARING HOUSING . . . 9.1125 A
GASKET, REVERSE GEAR HOUSING . . . 9.1015 A
GASKET, REVERSE GEAR OIL OUTLET TUBE . . . 9.1600 A
GASKET, ROCKER COVER . . . 1.8455 A
GASKET, SELECTOR VALVE HOUSING . . . 9.1140 A
GASKET, STARTING FLUID STRAINER . . . 12.6350 C
GASKET, STARTING MOTOR . . . 7.3004 A
GASKET, STARTING MOTOR HOLE COVER . . . 1.5375 A
GASKET, TACHOMETER DRIVE ADAPTOR . . . 7.4455 B
GASKET, THERMOSTAT HOUSING . . . 5.2110 B
GASKET, THERMOSTAT HOUSING COVER . . . 5.2130 B
GASKET, TORQUE CONVERTER TO FLYWHEEL HOUSING . . . 8.3002 A
GASKET, TURBO TO AIR INLET HOUSING ADAPTOR . . . 3.5423 A
GASKET, TURBOCHARGER AIR OUTLET ELBOW . . . 3.5418 A
GASKET, TURBOCHARGER EXHAUST OUTLET CONNECTION . . . 3.5325 A
GASKET, TURBOCHARGER EXHAUST INLET CONNECTION . . . 3.5307 A
GASKET, TURBOCHARGER EXHAUST OUTLET CONNECTION . . . 3.5225 A
GASKET, TURBOCHARGER PRESSURE RATIO CONTROLLER . . . 3.5705 A
GASKET, TURBOCHARGER PRESSURE RATIO CONTROLLER BASE . . . 3.5715 A
GASKET, WATER BY-PASS TUBE ELBOW . . . 5.2215 C
GASKET, WATER FILTER COVER . . . 5.7035 A
GASKET, WATER FLANGE (AT RAW WATER PUMP) . . . 5.5378 A
GASKET, WATER OUTLET MANIFOLD . . . 5.2010 A
GASKET, WATER OUTLET MANIFOLD ELBOW . . . 5.2037 A

PART NAME GROUP NO.

GASKET, WATER TEMPERATURE SWITCH ADAPTOR . . . 7.4510 C
GEAR AND SHAFT ASSY., GOVERNOR DRIVE . . . 2.8815 A
GEAR AND SHAFT ASSY., GOVERNOR DRIVE. . . 2.8815 A
GEAR AND SLEEVE ASSY., GOVERNOR DRIVE . . . 2.8815 A
GEAR ASSY., HYDRAULIC MARINE. . . 9.1001 A
GEAR ASSY., IDLER . . . 1.7220
GEAR ASSY., PLANETARY . . . 9.1080 A
GEAR BOX ASSY.. . . . 9.3002 A
GEAR SET, BLOWER ROTOR. . . 3.4080
GEAR SET, OIL PUMP. . . 4.1095 A
GEAR, ACCESSORY DRIVE . . . 1.7670 B
GEAR, ACCESSORY DRIVE SHAFT . . . 1.7642 B
GEAR, AUTOMATIC STARTING DRIVE. . . 7.2325 B
GEAR, AUTOMATIC STARTING DRIVEN . . . 7.2270 B
GEAR, BLOWER DRIVE. . . 3.4300
GEAR, CAMSHAFT. . . 1.7200
GEAR, CRANKSHAFT TIMING . . . 1.3145
GEAR, FLYWHEEL RING . . . 1.4010 A
GEAR, FRESH WATER PUMP DRIVE. . . 5.1190
GEAR, FUEL PUMP (DRIVE) . . . 2.2087
GEAR, FUEL PUMP DRIVE . . . 2.2290
GEAR, FUEL PUMP DRIVEN. . . 2.2088
GEAR, GEAR BOX DRIVE. . . 9.3021 A
GEAR, GOVERNOR DRIVE. . . 2.8855 A
GEAR, GOVERNOR DRIVEN SHAFT . . . 2.8805 A
GEAR, GOVERNOR OIL PUMP DRIVE . . . 2.8720 A
GEAR, GOVERNOR OIL PUMP DRIVEN. . . 2.8730 A
GEAR, HYDRAULIC PUMP DRIVE. . . .12.5030 A
GEAR, HYDRAULIC PUMP DRIVEN . . . .12.5035 A
GEAR, IDLER . . . 1.7222
GEAR, INJECTOR. . . 2.1180 A
GEAR, OIL PUMP. . . 4.1092 A
GEAR, OIL PUMP DRIVE. . . 4.1090 A
GEAR, OIL PUMP DRIVE (ON CRANKSHAFT). . . 4.1310 A
GEAR, OIL PUMP DRIVE (ON PUMP). . . 4.1380 A
GEAR, OIL PUMP DRIVEN . . . 4.1200 A
GEAR, RAW WATER PUMP DRIVE. . . 5.6320 A
GEAR, RAW WATER PUMP DRIVEN . . . 5.6330 A
GEAR, REDUCTION . . . 9.1310 A
GEAR, REDUCTION GEAR DRIVE. . . 8.1928 A
GEAR, REDUCTION GEAR DRIVEN . . . 8.1930 A
GEAR, REVERSE GEAR FLYWHEEL RING. . . 9.1205 A
GEAR, REVERSE RING. . . 9.1040 A
GEAR, REVERSE SUN . . . 9.1070 A
GEAR, VERNIER THROTTLE CONTROL WORM . . . 2.9141 A
GENERATOR ASSY. . . . 7.1001 A
GENERATOR ASSY., POWER. . . 7.5001 A
GENERATOR, DRIVE BEARING AND OIL SEAL RETAINER . . . 7.1525 A
GENERATOR, DRIVE BEARING OIL SEAL RETAINER . . . 7.1525 A
GLAND, BILGE PUMP SHAFT PACKING . . . .12.2070 A
GLAND, HEAT EXCHANGER SEAL RETAINER . . . 5.5027 A
GOVERNOR ASSY.. . . . 2.7001 A
GOVERNOR ASSY.. . . . 2.8030 A
GOVERNOR, AIR COMPRESSOR. . . .12.4305 A
GOVERNOR, OVERSPEED TRIP. . . 7.4611 C
GOVERNOR, TORQUE CONVERTER OUTPUT SHAFT. . . 8.3077 A
GOVERNOR, TORQUE CONVERTER OUTPUT SHAFT . . . 8.3077 A
GRILL, RADIATOR . . . 5.3210 A
GUARD, FAN. . . 5.4580 B
GUARD, GENERATOR DRIVE BELT & PULLEY. . . 7.1585 A
GUARD, GENERATOR DRIVE BELT AND PULLEY. . . 7.1585 A
GUIDE, CAM FOLLOWER . . . 1.8300
GUIDE, DIPSTICK . . . 4.6020 A
GUIDE, EXHAUST VALVE. . . 1.8320
GUIDE, EXHAUST VALVE BRIDGE . . . 1.8345
GUIDE, GEAR BOX DIPSTICK. . . 9.3425 A
GUIDE, GOVERNOR HIGH SPEED SPRING . . . 2.7620 A
GUIDE, GOVERNOR SPRING. . . 2.7620 A
GUIDE, GOVERNOR VARIABLE SPEED SPRING PLUNGER. . . 2.7780 A
GUIDE, OVERSPEED VALVE PISTON . . . 7.3735 C
GUIDE, OVERSPEED VALVE PISTON . . . 7.4735 C
GUIDE, REDUCTION GEAR DIPSTICK. . . 9.1400 A

H

HANDLE, FUEL STRAINER . . . 2.3170 A
HANDLE, HYDRAULIC STARTER CONTROL SHAFT . . . .12.6514 D
HANDLE, HYDRAULIC STARTER HAND PUMP. . . .12.6646 D
HANGER, THROTTLE BOOSTER SUPPORT. . . 2.9349 A
HARNESS, AIR HEATER WIRING. . . 7.8095 A
HARNESS, AIR SHUT-OFF WIRING. . . 7.4545 C
HARNESS, AIR SHUTOFF WIRING . . . 7.4545 C
HARNESS, CONTROL CABINET WIRING . . . 7.7060 A
HARNESS, ENGINE WIRING. . . 7.7001 A
HEAD ASSY., CYLINDER. . . 1.2001
HEAD, CYLINDER. . . 1.2001
HEATER ASSY.. . . . 7.8001 A
HEATER ASSY., AIR . . . 7.8001 A
HEATING UNIT, CALROD. . . .12.6400 C
HOOD ASSY., RADIATOR. . . .10.1020 A
HOSE, AIR INLET PIPE. . . 3.1270 A
HOSE, AIR SILENCER OUTLET ELBOW . . . 3.2023 A
HOSE, BILGE PUMP PRIMING TUBE . . . .12.2230 A
HOSE, BREATHER EXTENSION. . . 4.8175 A
HOSE, BREATHER EXTENSION PIPE . . . 4.8175 A
HOSE, CLUTCH RELEASE BEARING. . . 8.1320 A
HOSE, CYLINDER BLOCK WATER DRAIN TO OIL COOLER. . . 4.4329 A
HOSE, DE-AERATION TANK INLET. . . 5.3283 B
HOSE, EXHAUST MANIFOLD FRESH WATER INLET . . . 5.3432 B
HOSE, EXHAUST MANIFOLD FRESH WATER OUTLET. . . 5.3442 B
HOSE, EXPANSION TANK OUTLET . . . 5.3331 B
HOSE, FLEXIBLE BULK . . . .12.8550 B
HOSE, FUEL DRAIN FLEXIBLE . . . 2.5215 A
HOSE, FUEL SUPPLY TO STRAINER FLEXIBLE. . . 2.5010 A
HOSE, FUEL TANK FLEXIBLE. . . 2.6005 A
HOSE, HEAT EXCHANGER FRESH WATER INLET . . . 5.3295 B
HOSE, HEAT EXCHANGER FRESH WATER OUTLET. . . 5.6550 A

PART NAME . . . GROUP NO.

HOSE, HEAT EXCHANGER RAW WATER INLET TUBE . . . 5.5470 A
HOSE, HEAT EXCHANGER RAW WATER INLET TUBE. . . 5.6586 A
HOSE, HEAT EXCHANGER WATER INLET TUBE. . . 5.5470 A
HOSE, HYDRAULIC MARINE GEAR OIL FILTER TO COOLER. . . 4.4338 A
HOSE, HYDRAULIC STARTER (BULK) (LESS FITTINGS) . . . 12.6827 E
HOSE, HYDRAULIC STARTER ENGINE PUMP TO RESERVOIR. . . 12.6870 E
HOSE, HYDRAULIC STARTER FILTER TO ENGINE PUMP . . . 12.6840 E
HOSE, HYDRAULIC STARTER FILTER TO HAND PUMP . . . 12.6845 E
HOSE, HYDRAULIC STARTER FLEXIBLE HOSE (BULK) . . . 12.8520 B
HOSE, HYDRAULIC STARTER FUEL PRIMER . . 12.6950 E
HOSE, HYDRAULIC STARTER RESERVOIR TO FILTER . . . 12.6830 E
HOSE, HYDRAULIC STARTER TO RESERVOIR . . . 12.6865 E
HOSE, HYDRAULIC STARTER TO RESERVOIR. . 12.6865 E
HOSE, MARINE GEAR COOLER TO SELECTOR VALVE. . . 4.4343 A
HOSE, MARINE GEAR COOLER TO SELECTOR VALVE . . . 4.4343 A
HOSE, MARINE GEAR HYDRAULIC OIL FILTER TO . . . 4.4338 A
HOSE, MARINE GEAR HYDRAULIC PUMP TO OIL FILTER. . . 4.4337 A
HOSE, MARINE GEAR OIL INLET . . . 4.4335 A
HOSE, MARINE GEAR OIL OUTLET. . . 4.4330 A
HOSE, MARINE GEAR TO OIL PRESSURE PUMP . . . 4.4355 A
HOSE, MASTER CYLINDER TO REMOTE CONTROL VALVE . . . 12.6875 E
HOSE, OIL COOLER WATER INLET. . . 4.4213 A
HOSE, OIL COOLER WATER OUTLET . . . 4.4240 A
HOSE, OIL PRESSURE GAGE . . . 7.4074 A
HOSE, RADIATOR INLET. . . 5.3290 B
HOSE, RADIATOR OUTLET . . . 5.3330 B
HOSE, THERMOSTAT HOUSING COVER OUTLET. . . 5.2124 B
HOSE, THERMOSTAT HOUSING COVER OUTLET ELBOW. . . 5.2124 B
HOSE, THERMOSTAT HOUSING WATER OUTLET. . . 5.2105 B
HOSE, TURBOCHARGER AIR OUTLET CONNECTION. . . 3.5420 A
HOSE, WATER BY-PASS TUBE. . . 5.2165 C
HOSE, WATER CROSSOVER TUBE. . . 5.3474 B
HOSE, WATER FILTER INLET. . . 5.7090 A
HOSE, WATER FILTER OUTLET . . . 5.7100 A
HOUSING ASSY., AIR INLET. . . 3.3001 A
HOUSING ASSY., DRIVE. . . 12.6030 A
HOUSING ASSY., GEAR BOX . . . 9.3010 A
HOUSING ASSY., GOVERNOR . . . 2.8190 A
HOUSING ASSY., GOVERNOR CONTROL . . . 2.8976 A
HOUSING ASSY., GOVERNOR CONTROL EQUALIZER . . . 2.9023
HOUSING ASSY., GOVERNOR CONTROL LINK. . 2.7892 A
HOUSING ASSY., GOVERNOR VARIABLE SPEED SPRING. . . 2.7680 A
HOUSING ASSY., LIMITING SPEED GOVERNOR. . . 2.8977 A
HOUSING ASSY., OVERSPEED TRIP GOVERNOR. . . 7.4614 C
HOUSING ASSY., REVERSE GEAR . . . 9.1010 A
HOUSING ASSY., TORQUE CONVERTER DRIVE . . . 8.1665 A
HOUSING ASSY., TURBOCHARGER INTERMEDIATE. . . 3.5018 A
HOUSING ASSY., VARIABLE SPEED SPRING. . 2.7680 A
HOUSING ASSY, AIR INLET . . . 3.3001 A
HOUSING, ACCESSORY DRIVE. . . 1.7627 B
HOUSING, AIR INLET. . . 3.3003 A
HOUSING, AIR SHUTOFF CONTROL. . . 7.4550 C
HOUSING, ASSY., LIMITING SPEED GOVERNOR. . . 2.8977 A
HOUSING, BILGE PUMP IMPELLER. . . 12.2050 A
HOUSING, BLOWER . . . 3.4020
HOUSING, CLUTCH . . . 8.1010 A
HOUSING, CLUTCH BEARING . . . 8.1013 A
HOUSING, EXHAUST VALVE RESTRICTOR . . . 6.2133 A
HOUSING, FLYWHEEL . . . 1.5001 A
HOUSING, GEAR BOX OUTPUT SHAFT BEARING . . . 9.3046 A
HOUSING, GOVERNOR CONTROL . . . 2.7235 A
HOUSING, GOVERNOR CONTROL LINK. . . 2.7896 A
HOUSING, GOVERNOR DRIVE . . . 2.8780 A
HOUSING, GOVERNOR HIGH SPEED SPRING ADJUSTING SCREW . . . 2.7635 A
HOUSING, GOVERNOR VARIABLE SPEED SPRING. . . 2.7650 A
HOUSING, HYDRAULIC PUMP DRIVE . . . 12.5025 A
HOUSING, HYDRAULIC STARTER CLUTCH . . . 12.6510 D
HOUSING, HYDRAULIC STARTER DRIVE. . . 12.6504 D
HOUSING, HYDRAULIC STARTER ENGINE PUMP BEARING. . . 12.6557 D
HOUSING, HYDRAULIC STARTER MOTOR. . . 12.6525 D
HOUSING, INSTRUMENT PANEL (SUPPORT) . . 7.4006 A
HOUSING, INTERCOOLER. . . 3.5432 A
HOUSING, INTERCOOLER TO AIR INLET . . . 3.5421 A
HOUSING, OIL COOLER . . . 4.4050 A
HOUSING, OIL COOLER BY-PASS . . . 4.4130 A
HOUSING, OIL COOLER BY-PASS VALVE . . . 4.4130 A
HOUSING, OIL FILTER BY-PASS VALVE . . . 4.2388 A
HOUSING, OVERSPEED TRIP GOVERNOR SWITCH. . . 7.4677 C
HOUSING, OVERSPEED VALVE. . . 7.4727 C
HOUSING, POWER TAKE-OFF ADAPTOR . . . 8.1900 A
HOUSING, RAW WATER PUMP BEARING . . . 5.6133 A
HOUSING, RAW WATER PUMP DRIVE . . . 5.6010 A
HOUSING, RAW WATER PUMP IMPELLER. . . 5.6020 A
HOUSING, REDUCTION GEAR . . . 8.1920 A
HOUSING, REVERSE GEAR DRIVE SHAFT BEARING . . . 9.1120 A
HOUSING, THERMO FAN DRIVE . . . 5.4362 A
HOUSING, THERMOSTAT . . . 5.2050 B
HOUSING, TURBOCHARGER COMPRESSOR. . . 3.5022 A
HOUSING, TURBOCHARGER EXHAUST INLET . . 3.5003 A
HOUSING, TURBOCHARGER TURBINE . . . 3.5003 A
HOUSING, VERNIER THROTTLE CONTROL . . . 2.9136 A
HUB ASSY., IDLER GEAR . . . 1.7250

PART NAME GROUP NO.

HUB ASSY., VIBRATION DAMPER . . . . 1.3230 B
HUB, ACCESSORY DRIVE GEAR . . . . 1.7643 B
HUB, AIR COMPRESSOR DRIVE . . . . .12.4040 A
HUB, BLOWER ROTOR GEAR. 3.4130
HUB, CRANKSHAFT PULLEY. . . . . 1.3310 C
HUB, DRIVE PULLEY . . . . 1.7610 B
HUB, FAN. . . . . 5.4235 A
HUB, FLYWHEEL FLEXIBLE COUPLING . . . . . 1.4080 A
HUB, GENERATOR DRIVE PULLEY . . . . 7.1510 A
HUB, GOVERNOR DRIVE . . . . 2.8754 A
HUB, GOVERNOR OPERATING SHAFT . . . . . . 2.8973 A
HUB, HYDRAULIC PUMP COUPLING. . . . . . . 9.1545 A
HUB, HYDRAULIC PUMP DRIVE . . . . 9.1540 A
HUB, INTERNAL DRIVEN GEAR . . . . 8.1933 A

I

IMPELLER AND SHAFT ASSY., BILGE
PUMP. . . . . .12.2040 A
IMPELLER, FRESH WATER PUMP. 5.1110
IMPELLER, RAW WATER PUMP. . . . . 5.6230 A
INDICATOR, AIR CLEANER RESTRICTION. . . . 3.1002 A
INJECTOR ASSY.. . . . . 2.1001 A
INSERT, CYLINDER LINER. 1.6187
INSERT, EXHAUST VALVE 1.8330
INSTALLATION KIT, WATER FILTER. . . . . . 5.7010 A
INSULATION, AIR SILENCER HOUSING. . . . . 3.2030 A
INSULATOR ASSY., CRANKSHAFT PULLEY
HUB . . . . 1.3311 C
INSULATOR BLANKET, TURBOCHARGER . . . . . 3.5535 A
INSULATOR, AIR HEATER . . . . 7.8130 A
INSULATOR, BLANKET TURBOCHARGER . . . . . 3.5535 A
INSULATOR, CONTROL CABINET TO
SUPPORT . . . . 7.6005 A
INSULATOR, TIME DELAY RELAY
MOUNTING. . . . . 7.4713 C
INSULATOR, TIME DELAY RELAY MOUNTING. . 7.4713 C
INTERCOOLER, TURBOCHARGER . . . . 3.5425 A

J

JUNCTION BLOCK, AIR CYLINDER CONTROL. . 1.1053

K

KIT, ACCESSORY DRIVE SEAL . . . . 1.7602 B
KIT, BREATHER FILTER POWER TAKE OFF. . 8.1966 A
KIT, CLUTCH PRESSURE PLATE. . . . . 8.1085 A
KIT, CLUTCH RELEASE SPRING. . . . . 8.1101 A
KIT, CLUTCH SPRING. . . . . 8.1101 A
KIT, HYDRAULIC MARINE GEAR
OVERHAUL GASKET . . . . 9.1017 A
KIT, HYDRAULIC MARINE GEAR OVERHAUL
GASKET. . . . . 9.1017 A
KIT, UNITIZED AIR SHUTDOWN. . . . . 3.3094 A
KIT, VIBRATION DAMPER RECONDITIONING. . 1.3146
KITS, SERVICE . . . . .12.8715 C
KNOB AND PIN ASSY., THROTTLE CONTROL
LEVER . . . . 2.9642 A
KNOB, STARTING AID PUMP PLUNGER . . . .12.6330 C
KNOB, THROTTLE CONTROL. . . . . 2.9100 A
KNOB, VERNIER THROTTLE CONTROL. . . . . 2.9135 A

L

LAMP, INSTRUMENT PANEL. . . . . 7.4100 A
LAMP, TELL TALE . . . . 7.4580 C
LEAD, AIR HEATER COIL HIGH TENSION. . . 7.8110 A
LEVER AND SUPPORT ASSY., AIR INLET
SHUTDOWN CONNECTOR. . . . . 3.3097 A
LEVER ASSY., AIR INLET HOUSING
SHUTDOWN RESET. . . . . 3.3110 A
LEVER ASSY., CLUTCH HAND CONTROL. . . . 8.1470 A
LEVER ASSY., GOVERNOR CONTROL LINK
HOUSING OPERATING . . . . 2.7902 A
LEVER ASSY., GOVERNOR CONTROL LINK
OPERATING . . . . 2.7317 A
LEVER ASSY., GOVERNOR DIFFERENTIAL. . . 2.7310 A
LEVER ASSY., GOVERNOR DIFFERENTIAL
(LIMITING SPEED). . . . . 2.8981 A
LEVER, AIR INLET HOUSING SHUTDOWN
VALVE . . . . 3.3090 A
LEVER, ANTI-STALL . . . . 2.8553 A
LEVER, CLUTCH HAND CONTROL. . . . . 8.1470 A
LEVER, CLUTCH RELEASE YOKE. . . . . 8.1142 A
LEVER, CONTROL VALVE SHUT-OFF . . . . . . 9.1180 A
LEVER, EXHAUST RESTRICTOR . . . . 6.2142 A
LEVER, GOV. OPERATING SHAFT . . . . 2.7280 A
LEVER, GOVERNOR CONTROL . . . . 2.9410 A
LEVER, GOVERNOR CONTROL EQUALIZER
SHAFT 2.9028
LEVER, GOVERNOR CONTROL SHAFT . . . . . . 2.9350 A
LEVER, GOVERNOR COVER SHUTDOWN SHAFT. . 2.7165 A
LEVER, GOVERNOR COVER THROTTLE SHAFT. . 2.7170 A
LEVER, GOVERNOR OPERATING SHAFT . . . . . 2.7280 A
LEVER, GOVERNOR OPERATING SHAFT . . . . . 2.8975 A
LEVER, GOVERNOR ROCKER SHAFT
THROTTLE. . . . . 8.3450 A
LEVER, GOVERNOR SPEED ADJUSTING . . . . . 2.8420 A
LEVER, GOVERNOR SPEED ADJUSTING
FLOATING. . . . . 2.8410 A
LEVER, GOVERNOR SPEED ADJUSTING
SPRING. . . . . 8.3460 A
LEVER, GOVERNOR SPEED ADJUSTING
TERMINAL. . . . . 2.8450 A
LEVER, GOVERNOR THROTTLE CONTROL. . . . 2.8982 A
LEVER, INJECTOR CONTROL TUBE. 2.9009
LEVER, INJECTOR CONTROL TUBE (LOAD
LIMIT ADJUSTING). 2.9017
LEVER, INJECTOR CONTROL TUBE RACK . . . 2.9014
LEVER, SELECTOR VALVE OPERATING . . . . . 9.1175 A
LEVER, THROTTLE CONTROL (MASTER). . . . 2.9635 A
LEVER, THROTTLE CONTROL CROSS SHAFT . . 2.9340 A
LEVER, THROTTLE CONTROL CROSS SHAFT . . 2.9685 A
LEVER, THROTTLE CONTROL ROD LOWER . . . 2.9250 A
LEVER, THROTTLE CONTROL ROD REAR. . . . 2.9300 A
LEVER, VARIABLE SPEED SPRING. . . . . . . 2.7730 A
LIGHT, AUTOMATIC STARTING PILOT . . . . . 7.2355 B
LINER, CYLINDER 1.6180
LINK, AUTOMATIC STARTING SOLENOID
ROD . . . . 7.2255 B
LINK, BELT FASTENER . . . . 1.3335 D
LINK, CLUTCH RELEASE YOKE . . . . 8.1315 A
LINK, GOVERNOR OPERATING LEVER
CONNECTING. . . . . 2.7312 A

PART NAME GROUP NO.

LINK, GOVERNOR OPERATING LEVER TO BELL CRANK . . . . . 2.8970 A
LINK, GOVERNOR OPERATING LEVER TO BELL CRANK. . . . . 2.8970 A
LINK, INJECTOR CONTROL TUBE TO GOVERNOR. 2.9022
LINK, THROTTLE CONTROL EQUALIZING . . . 2.9430 A
LOCK, CLUTCH ADJUSTING NUT. . . . . . . 8.1145 A
LOCK, CLUTCH DRIVE SHAFT BEARING RETAINER. . . . . 8.1700 A
LOCK, EXHAUST VALVE SPRING. 1.8370
LOCKNUT, GOVERNOR HIGH SPEED SPRING RETAINER. . . . . 2.7615 A
LOCKRING, ACCESSORY DRIVE . . . . 1.7650 B
LOCKRING, GENERATOR DRIVE BEARING . . . 7.1545 A
LOCKWASHER, BLOWER DRIVE GEAR 3.4340
LUBRICATING COMPOUND (THREAD) . . . . .12.8110 A
LUG, CIRCUIT BREAKER TERMINAL STUD. . . 7.6206 A

M

MANIFOLD, AIR INLET . . . . 3.3310 A
MANIFOLD, EXHAUST . . . . 6.1001 A
MANIFOLD, HEAT EXC. WATER (BETWEEN OUTLET ELBOWS). . . . . 5.2126 B
MANIFOLD, HEAT EXCHANGER WATER (BETWEEN. . . . . 5.2126 B
MANIFOLD, WATER OUTLET. . . . . 5.2001 A
MEDALLION, INSTRUMENT PANEL . . . . . . 7.4099 A
MEMBER, RADIATOR SIDE . . . . 5.3220 A
MOTOR ASSY., GOVERNOR SYNCHRONIZING . . 2.8182 A
MOTOR ASSY., STARTING . . . . 7.3001 A
MOTOR, AUTOMATIC STARTING . . . . 7.2300 B
MOUNTING (ANTI-VIBRATION) . . . . 7.4010 A
MOUNTING ADAPTOR, POWER TAKE-OFF ASSY. . . . . 8.1004 A
MOUNTING ASSY.. VOLTAGE REG.. . . . . . 7.1612 A
MOUNTING AS VOLTAGE REGULATOR . . . 7.1612 A
MOUNTING, AN -VIBRATION. . . . . 7.4010 A
MOUNTING, ASSY., VOLTAGE REGULATOR. . . 7.1612 A
MOUNTING, ENGINE FRONT SUPPORT ELASTIC . . . . .11.1072 A
MOUNTING, ENGINE FRONT SUPPORT ELASTIC. . . . .11.1072 A
MOUNTING, ENGINE REAR SUPPORT ELASTIC . . . . .11.1120 A
MOUNTING, ENGINE REAR SUPPORT ELASTIC . . . . .11.1120 A
MOUNTING, TACHOMETER. . . . . 7.4064 A
MUFFLER ASSY., EXHAUST. . . . . 6.2001 A

N

NAME PLATE, (RADIATOR). . . . . 5.3268 A
NAME PLATE, GOVERNOR. . . . . 2.7002 A
NAME, PLATE, GOVERNOR . . . . 2.7002 A
NECK ASSY., RADIATOR FILLER . . . . . . 5.3100 A
NECK, EXPANSION TANK FILLER . . . . . . 5.5120 A
NOZZLE, AIR HEATER SPRAY. . . . . 7.8050 A
NOZZLE, CONNECTING ROD SPRAY. 1.6010
NOZZLE, REDUCTION GEAR OIL. . . . . . . 9.1360 A
NOZZLE, STARTING AID PUMP TUBE. . . . .12.6375 C
NUT ASSY., MASTER CYLINDER END. . . . .12.6817 E

PART NAME GROUP NO.

NUT, AIR HEATER INSULATOR . . . . 7.8150 A
NUT, BLOWER DRIVE GEAR HUB. 3.4330
NUT, CLUTCH ADJUSTING . . . . 8.1144 A
NUT, CYLINDER HEAD STUD 1.2040
NUT, INJECTOR VALVE . . . . 2.1030 A
NUT, OIL FILTER COVER . . . . 4.2320 A
NUT, PROPELLER DRIVE FLANGE . . . . . . 9.1435 A
NUT, THROTTLE BOOSTER SUPPORT . . . . . 2.9349 A

O

OIL SEAL, GOVERNOR BASE . . . . 8.3385 A
ORIFICE, CONNECTING ROD 1.6020
OVERHAUL KIT, FUEL PUMP 2.2004

P

PACKING, BILGE PUMP SHAFT . . . . . . .12.2060 A
PACKING, EXHAUST OUTLET ADAPTOR . . . . 6.2125 A
PACKING, FUEL STRAINER REGULATOR VALVE . . . . . 2.3230 A
PACKING, GOVERNOR VARIABLE SPEED SPRING LEVER SHAFT. . . . . 2.7750 A
PAINT, ENGINE TOUCH-UP (ALPINE GREEN). . . . . .12.8001 A
PAN, GEAR BOX OIL . . . . 9.3160 A
PAN, OIL. . . . . 4.7001 A
PAN, OIL - LOWER. . . . . 4.7020 A
PAN, OIL - UPPER. . . . . 4.7010 A
PANEL, AUTOMATIC STARTING CABINET . . . 7.2207 B
PANEL, INSTRUMENT . . . . 7.4005 A
PEDAL ASSY., HYDRAULIC STARTER REMOTE CONTROL. . . . . .12.6822 E
PICK UP, GOVERNOR HIGH SPEED. . . . . . 2.8426 A
PILLOW BLOCK UNIT . . . . 8.1730 A
PIN SET, BELT FASTENER. . . . . 1.3330 D
PIN, BUSHING GUIDE. . . . . 2.1165 A
PIN, FORWARD CLUTCH . . . . 9.1215 A
PIN, GOV. DIFFERENTIAL LEVER. . . . . . 2.7315 A
PIN, GOV. OPERATING SHAFT LEVER . . . . 2.7300 A
PIN, GOVERNOR CONTROL WIRE SWIVEL . . . 2.9426 A
PIN, GOVERNOR DIFFERENTIAL LEVER. . . . 2.7315 A
PIN, GOVERNOR OPERATING SHAFT LEVER . . 2.7300 A
PIN, GOVERNOR WEIGHT. . . . . 2.7430 A
PIN, INJECTOR AND EXHAUST VALVE ROCKER ARM CLEVIS 1.8150
PIN, INJECTOR STOP. . . . . 2.1100 A
PIN, PISTON 1.6140
PIN, PROPELLER DRIVE SHAFT COUPLING. . . . . 9.1445 A
PIN, PROPELLER DRIVE SHAFT COUPLING . . 9.1445 A
PIN, REVERSE GEAR HOUSING CLUTCH DRIVE . . . . . 9.1025 A
PIN, VERNIER THROTTLE CONTROL LOCK BUTTON. . . . . 2.9146 A
PINION, CLUTCH ADJUSTING RING . . . . . 8.1147 A
PINION, PLANETARY GEAR. . . . . 9.1082 A
PINION, REDUCTION GEAR. . . . . 9.1305 A
PIPE ASSY., BREATHER. . . . . 4.8001 A
PIPE, AIR CLEANER TO INLET HOUSING. . . 3.1260 A
PIPE, AIR CLEANER TO INLET HSG. . . . . 3.1260 A
PIPE, BLOWER DRIVE BEARING OIL. . . . . 4.1660 B
PIPE, BREATHER. . . . . 4.8001 A

PART NAME	GROUP NO.
PIPE, BREATHER EXTENSION	4.8170 A
PIPE, CONVERTER OIL TANK FILLER	8.3835 B
PIPE, CONVERTER OIL TANK FILLER	11.1251 A
PIPE, EXHAUST	6.2090
PIPE, EXHAUST	6.2090 A
PIPE, FUEL	2.4020
PIPE, OIL PUMP INLET	4.1510 B
PIPE, OIL PUMP OUTLET	4.1580 B
PIPE, RADIATOR OVERFLOW	5.3160 A
PISTON ASSY.	1.6110
PISTON ASSY., MASTER CYLINDER OPERATING	12.6815 E
PISTON, EXHAUST RESTRICTOR AIR CYLINDER	6.2203 A
PISTON, FAST IDLE AIR CYLINDER	2.7860 A
PISTON, FORWARD CLUTCH	9.1225 A
PISTON, GOVERNOR SERVO MOTOR	2.8510 A
PISTON, GOVERNOR SPEED ADJUSTING	2.7612 A
PISTON, HYDRAULIC STARTER	12.6537 D
PISTON, HYDRAULIC STARTER ACCUMULATOR	12.6580 D
PISTON, HYDRAULIC STARTER ENGINE PUMP	12.6607 D
PISTON, HYDRAULIC STARTER HAND PUMP	12.6638 D
PISTON, OVERSPEED VALVE	7.4731 C
PISTON, REVERSE CLUTCH	9.1030 A
PIVOT, GOVERNOR BAND LEVEL ADJUSTING	2.8423 A
PLATE ASSY., ACCESSORY DRIVE	1.7630 P
PLATE, AIR COMP. DRIVE	12.4037 A
PLATE, AIR COMPRESSOR DRIVE	12.4037 A
PLATE, AIR INLET HOUSING SHUTDOWN CONTROL	3.3260 A
PLATE, AIR INLET HOUSING STRIKER	3.3020 A
PLATE, AIR INLET HSG. STRIKER	3.3020 A
PLATE, AUTOMATIC STARTING CABINET NAME	7.2212 B
PLATE, BLOWER HOUSING END	3.4140
PLATE, BLOWER ROTOR GEAR HUB	3.4135
PLATE, CLUTCH ADJUSTING NUT LOCK WEAR	8.1146 A
PLATE, CLUTCH PRESSURE	8.1080 A
PLATE, CYLINDER BLOCK END FRONT	1.1010
PLATE, CYLINDER BLOCK END-REAR	1.1020
PLATE, DIPSTICK ADAPTOR	4.6060 A
PLATE, DRIVING	8.1035 A
PLATE, EXHAUST MANIFOLD COVER	6.1100 A
PLATE, FLYWHEEL CLUTCH DRIVING	1.4070 A
PLATE, FLYWHEEL FLEXIBLE COUPLING	1.4085 A
PLATE, FORWARD CLUTCH	9.1235 A
PLATE, FORWARD CLUTCH DISC	9.1235 A
PLATE, FORWARD CLUTCH REACTION	9.1245 A
PLATE, GENERATOR DRIVE PULLEY SHAFT COUPLING	7.1550 A
PLATE, GENERATOR DRIVE PULLEY SHAFT COUPLING	7.1550 A
PLATE, HYDRAULIC PUMP DRIVE	12.5015 A
PLATE, HYDRAULIC STARTER ENGINE PUMP DRIVE	12.6593 D
PLATE, HYDRAULIC STARTER VALVE	12.6520 D
PLATE, INJECTOR CONTROL TUBE LEVER	2.9019
PLATE, OPTION & ACCESSORY NAME	1.8500 A
PLATE, OPTION AND ACCESSORY NAME	1.8500 A
PLATE, RAW WATER PUMP DRIVE	5.6410 A
PLATE, REDUCTION GEAR COVER	8.1925 A
PLATE, REVERSE CLUTCH DISC	9.1045 A
PLATE, REVERSE CLUTCH REACTION	9.1060 A
PLATE, THROTTLE CONTROL INDICATOR	2.9170 A
PLATE, TIME DELAY RELAY MOUNTING	7.4711 C
PLATE, VOLTAGE REGULATOR MOUNTING	7.1610 A
PLATE, VOLTAGE REGULATOR MOUNTING	7.1610 A
PLATE, WATER FILTER LOWER	5.7045 A
PLATE, WATER FILTER SUMP	5.7023 A
PLATE, WATER FILTER UPPER	5.7043 A
PLUG, BLOWER ROTOR SHAFT	3.4037
PLUG, FUEL FILTER	2.3480 A
PLUG, FUEL PUMP VALVE	2.2170
PLUG, FUEL STRAINER COVER	2.3100 A
PLUG, GOVERNOR HOUSING DUMMY HOLE	2.8200 A
PLUG, GOVERNOR RELIEF VALVE	2.8685 A
PLUG, GOVERNOR SPEED ADJUSTING TERMINAL SLEEVE	2.8485 A
PLUG, GOVERNOR SUB-CAP	2.8165 A
PLUG, HYDRAULIC STARTER ENGINE PUMP RELIEF VALVE	12.6625 D
PLUG, MASTER CYLINDER FILLER	12.6814 F
PLUG, OIL COOLER BY-PASS VALVE	4.4160 A
PLUG, OIL FILTER BY-PASS	4.2488 A
PLUG, OIL FILTER BY-PASS	8.1985 A
PLUG, OIL FILTER BY-PASS	9.1758 A
PLUG, OIL FILTER BY-PASS VALVE	4.2488 A
PLUG, OIL FILTER PRESSURE REGULATOR	8.3888 B
PLUG, OIL PAN DRAIN	4.7080 A
PLUG, OIL PUMP RELIEF VALVE	4.1270 A
PLUG, SELECTOR VALVE POPPET RETAINER	9.1151 A
PLUG, TACHOMETER DRIVE ADAPTOR BEARING	7.4432 B
PLUNGER & BUSHING ASSY., INJECTOR	2.1160 A
PLUNGER AND BUSHING ASSY., INJECTOR	2.1160 A
PLUNGER ASSY., GOVERNOR PILOT VALVE	2.8600 A
PLUNGER, FAST IDLE AIR CYLINDER	2.7865 A
PLUNGER, GOVERNOR LOW SPEED SPRING	2.7560 A
PLUNGER, GOVERNOR RELIEF VALVE	2.8650 A
PLUNGER, GOVERNOR VARIABLE SPEED SPRING	2.7770 A
PLUNGER, OVERSPEED TRIP GOVERNOR PILOT VALVE	7.4620 C
POPPET, SELECTOR VALVE	9.1145 A
POWER TAKE-OFF ASSY.	8.1001 A
PRE-CLEANER ASSY., AIR	3.1100 A
PRIMER PUMP, FUEL	2.5490 A
PRIMER, FUEL	12.6655 D
PULLEY & HUB ASSY., FAN	5.4015 A
PULLEY AND HUB ASSY., FAN	5.4015 A
PULLEY ASSEMBLY, BILGE PUMP DRIVEN	12.2140 A
PULLEY, ACCESSORY DRIVE	1.7605 B
PULLEY, AIR COMP. DRIVE	12.4017 A
PULLEY, AIR COMPRESSOR	12.4015 A
PULLEY, AIR COMPRESSOR DRIVE	12.4017 A
PULLEY, CRANKSHAFT	1.3280 C
PULLEY, CRANKSHAFT FRONT POWER TAKE-OFF	8.1908 A
PULLEY, FRONT BALANCE	1.7130
PULLEY, GENERATOR	7.1500 A
PULLEY, GENERATOR DRIVE	7.1505 A

PART NAME GROUP NO.

PULLEY, HYDRAULIC PUMP DRIVE . . . 12.5007 A
PULLEY, HYDRAULIC STARTER ENGINE PUMP DRIVEN . . . 12.6675 D
PULLEY, RAW WATER PUMP DRIVE . . . 5.6400 A
PULLEY, STARTER DRIVE DRIVEN . . . 12.6070 A
PULLEY, STARTING ENGINE DRIVE . . . 12.6010 A
PUMP ASSY., AIR HEATER . . . 7.8200 A
PUMP ASSY., BILGE . . . 12.2001 A
PUMP ASSY., CONVERTER PRESSURE . . . 8.3600 A
PUMP ASSY., FRESH WATER . . . 5.1001
PUMP ASSY., FUEL . . . 2.2001
PUMP ASSY., HYD. STARTER ENGINE . . . 12.6590 D
PUMP ASSY., HYDRAULIC . . . 12.5001 A
PUMP ASSY., HYDRAULIC MARINE GEAR OIL . . . 9.1475 A
PUMP ASSY., HYDRAULIC MARINE GEAR CIL . . . 9.1475 A
PUMP ASSY., HYDRAULIC STARTER ENGINE . . . 12.6590 D
PUMP ASSY., HYDRAULIC STARTER HAND . . . 12.6630 D
PUMP ASSY., HYDRAULIC STARTER HAND . . . 12.6630 D
PUMP ASSY., MARINE GEAR OIL . . . 9.1475 A
PUMP ASSY., OIL . . . 4.1001 A
PUMP ASSY., RAW WATER . . . 5.6001 A
PUMP ASSY., STARTING AID . . . 12.6305 C
PUNCTURING TOOL ASSY., STARTING FLUID CAPSULE . . . 12.6380 C

Q

QUADRANT, THROTTLE CONTROL LEVER . . . 2.9655 A

R

RACK, INJECTOR . . . 2.1170 A
RADIATOR . . . 5.3001 A
RECONDITIONING KIT, FRESH WATER PUMP . . . 5.1002
RECONDITIONING KIT, RAW WATER PUMP . . . 5.6025 A
RECTIFIER, BATTERY CHARGING . . . 7.1890 A
REGULATOR ASSY. . . . 7.1605 A
REGULATOR ASSY., VOLTAGE . . . 7.1597 A
REGULATOR ASSY., VOLTAGE . . . 7.1605 A
REGULATOR, ASSY., VOLTAGE . . . 7.1605 A
REGULATOR, CONTROL VALVE PRESSURE . . . 9.1190 A
REGULATOR, OIL PRESSURE . . . 4.1670 C
RELAY, ALARM BELL . . . 7.4514 C
RELAY, AUTOMATIC STARTING . . . 7.2330 B
RELAY, TIME DELAY . . . 7.4707 C
RELIEF VALVE, OIL PRESSURE . . . 4.1671 C
REMOTE STARTING KIT, HYDRAULIC STARTER . . . 12.6807 E
REPAIR KIT, FAN . . . 5.4003 A
REPAIR KIT, PLANETARY GEAR ASSY. . . . 9.1086 A
REPLACEMENT KIT, FRESH WATER PUMP SEAL . . . 5.1115
REPLACEMENT KIT, RAW WATER PUMP SEAL & IMPELLER . . . 5.6220 A
RESERVOIR ASSY., GOV. OIL . . . 2.8905 A
RESERVOIR ASSY., GOVERNOR OIL . . . 2.8905 A
RESERVOIR, HYDRAULIC STARTER . . . 12.6551 D
RESISTOR ASSY., POWER GENERATOR FIELD DISCHARGER . . . 7.6745 A

PART NAME GROUP NO.

RESISTOR, AMMETER . . . 7.4023 A
RESISTOR, TIME DELAY RELAY . . . 7.4709 C
RETAINER ASSY., ACCESSORY DRIVE . . . 1.7645 B
RETAINER, ACCESSORY DRIVE BEARING . . . 1.7656 B
RETAINER, BILGE PUMP SHAFT BEARING . . . 12.2120 A
RETAINER, BLOWER DRIVE COUPLING . . . 3.4420
RETAINER, BLOWER ROTOR FRONT BEARING . . . 3.4050
RETAINER, BLOWER ROTOR REAR BEARING . . . 3.4070
RETAINER, BREATHER PAD . . . 4.8065 A
RETAINER, CAMSHAFT GEAR NUT . . . 1.7207
RETAINER, CLUTCH DRIVE SHAFT BEARING . . . 8.1650 A
RETAINER, CLUTCH DRIVE SHAFT BEARING . . . 8.1690 A
RETAINER, CLUTCH PILOT BEARING . . . 1.4045 A
RETAINER, CLUTCH PILOT BEARING . . . 8.1460 A
RETAINER, CRANKSHAFT PULLEY . . . 1.3290 C
RETAINER, DRIVE PULLEY HUB OIL SEAL . . . 1.7615 B
RETAINER, FAN SHAFT BEARING . . . 5.4140 A
RETAINER, FAN SHAFT BEARING (FOR CUST. FURNISHED HUB) . . . 5.4140 A
RETAINER, FRESH WATER PUMP BEARING AND SEAL . . . 5.1071
RETAINER, FRESH WATER PUMP BEARING AND SEAL . . . 5.1071
RETAINER, GEAR BOX OUTPUT SHAFT BEARING OIL SEAL . . . 9.3130 A
RETAINER, GENERATOR DRIVE BEARING AND OIL SEAL . . . 7.1520 A
RETAINER, GENERATOR DRIVE BEARING & OIL SEAL . . . 7.1520 A
RETAINER, GOVERNOR DRIVE SHAFT BEARING . . . 2.8850 A
RETAINER, GOVERNOR FUEL ROD SPRING . . . 2.8140 A
RETAINER, GOVERNOR HIGH SPEED SPRING . . . 2.7610 A
RETAINER, GOVERNOR SHUTDOWN SHAFT (PACKING) . . . 2.7155 A
RETAINER, GOVERNOR THROTTLE SHAFT (PACKING) . . . 2.7150 A
RETAINER, GOVERNOR VARIABLE SPEED SPRING . . . 2.7750 A
RETAINER, HEAT EXCHANGER SEAL . . . 5.5025 A
RETAINER, HYDRAULIC PUMP COUPLING . . . 9.1550 A
RETAINER, IDLER GEAR BEARING . . . 1.7227
RETAINER, INJECTOR GEAR . . . 2.1190 A
RETAINER, OIL FILTER SPRING . . . 4.2315 A
RETAINER, OIL FILTER SPRING . . . 8.1980 A
RETAINER, OIL FILTER SPRING . . . 9.1787 A
RETAINER, OIL FILTER TUBE ADAPTOR TO BY-PASS VALVE SPRING . . . 4.3060 A
RETAINER, OIL PUMP INLET PIPE SCREEN . . . 4.1560 B
RETAINER, PILOT BEARING . . . 9.1211 A
RETAINER, PISTON PIN . . . 1.6150
RETAINER, PUMP COUPLING . . . 9.1550 A
RETAINER, PUSH ROD . . . 1.8250
RETAINER, TACHOMETER . . . 7.4063 A
RING SET, PISTON . . . 1.6115
RING, AIR COMPRESSOR DRIVE COUPLING . . . 12.4055 A
RING, AIR CYLINDER EXHAUST RESTRICTOR . . . 6.2206 A
RING, BLOWER DRIVE SHAFT . . . 3.4446 A
RING, CAMSHAFT INTERMEDIATE BEARING LOCK . . . 1.7050
RING, CLUTCH DRIVING . . . 8.1018 A

PART NAME GROUP NO.

RING, CLUTCH REACTION PLATE SNAP. . . . 9.1065 A
RING, CROSSHEAD PISTON SEAL 1.6106
RING, DRAIN TANK BASE . . . . 1.1200 A
RING, DRAIN TANK RETAINER . . . . 1.1220 A
RING, ENGINE FRONT TRUNNION MOUNTING SUPPORT CUSHION . . . . .11.1094 A
RING, ENGINE FRONT TRUNNION MOUNTNG SUPPORT CUSHION . . . . .11.1094 A
RING, FRESH WATER PUMP BODY IMPELLER DEFLECTOR 5.1120
RING, FUEL STRAINER SHELL RETAINING . . 2.3070 A
RING, GOVERNOR OIL PUMP HOUSING SEAL. . . . . 2.8700 A
RING, GOVERNOR OIL PUMP HOUSING SEAL. . 2.8700 A
RING, HYDRAULIC PUMP COUPLING . . . . . 9.1545 A
RING, HYDRAULIC PUMP DRIVE COUPLING . .12.5038 A
RING, HYDRAULIC STARTER ENGINE PUMP. . . . . .12.6611 D
RING, INJECTOR SEAL . . . . 2.1040 A
RING, PISTON COMPRESSION. 1.6120
RING, PISTON OIL CONTROL. 1.6130
RING, PLANETARY GEAR SNAP . . . . 9.1095 A
RING, RAW WATER PUMP BEARING RETAINER. . . . . 5.6140 A
RING, RAW WATER PUMP SHAFT SEAL . . . . 5.6176 A
RING, RAW WATER PUMP SHAFT SEAL FRICTION. . . . . 5.6175 A
RING, REDUCTION GEAR DRIVE SHAFT OIL SEAL. . . . . 9.1330 A
RING, REDUCTION GEAR SHAFT PILOT. . . . 8.1941 A
RING, REVERSE CLUTCH DISC PLATE SNAP. . . . . 9.1050 A
RING, REVERSE CLUTCH DISC PLATE SNAP. . 9.1050 A
RING, TORQUE CONVERTER DRIVE SHAFT SEAL. . . . . 8.1666 A
RING, TURBOCHARGER NOZZLE . . . . 3.5006 A
RISER, GOVERNOR . . . . 2.7380 A
RISER, GOVERNOR . . . . 8.3420 A
ROD AND CLEVIS ASSY. THROTTLE CONTROL . . . . 2.9280 A
ROD AND CLEVIS ASSY., THROTTLE CONTROL . . . . 2.9280 A
ROD ASSY., MASTER CYLINDER PISTON PUSH. . . . . .12.6818 E
ROD, AIR CYLINDER EXHAUST RESTRICTOR. . 6.2209 A
ROD, AIR INLET HOUSING SHUTDOWN VALVE CROSSOVER . . . . 3.3095 A
ROD, AIR SHUT-OFF SOLENOID CONTROL. . . 7.4538 C
ROD, AIR SHUTOFF SOLENOID CONTROL . . . 7.4538 C
ROD, ANTI-STALL . . . . 2.8554 A
ROD, AUTOMATIC STARTING SOLENOID. . . . 7.2250 B
ROD, CONTROL ASSY. TO OPERATING CONTROL . . . . 2.9637 A
ROD, GOVERNOR CONNECTING. . . . . 2.7905 A
ROD, GOVERNOR FUEL. . . . . 2.8070 A
ROD, PUSH 1.8180
ROD, THROTTLE CONTROL LEVER TO GOVERNOR. . . . . 2.9730 A
ROD, THROTTLE CONTROL LEVER TO BELL CRANK . . . . 2.9720 A
ROLLER SET, CAM FOLLOWER. 1.8265
ROTATING ASSY., TURBOCHARGER. . . . . . 3.5030 A
ROTOR SET, HYDRAULIC PUMP . . . . 9.1500 A
ROTOR, BLOWER 3.4030
ROTOR, HYDRAULIC STARTER. . . . . . . .12.6535 D

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SCREEN BLOWER 3.4025
SCREEN, AIR CLEANER . . . . 3.1040 A
SCREEN, AIR SILENCER. . . . . 3.2007 A
SCREEN, AIR SILENCER INSULATION . . . . 3.2008 A
SCREEN, BLOWER. 3.4025
SCREEN, OIL PUMP INLET. . . . . 4.1530 B
SCREW ASSY., GOVERNOR BUFFER. . . . . . 2.7810 A
SCREW, CONTROL VALVE SHUT-OFF LOCK. . . 9.1173 A
SCREW, CONVERTER OIL FILTER COVER . . . 8.3876 B
SCREW, FAN BRACKET ADJUSTING. . . . . . 5.4290 A
SCREW, FUEL FILTER COVER. . . . . 2.3410 A
SCREW, FUEL STRAINER COVER. . . . . . . 2.3120 A
SCREW, GOVERNOR BUFFER (LIMITING SPEED). . . . . 2.8983 A
SCREW, GOVERNOR HI-SPEED STOP . . . . . 2.8520 A
SCREW, GOVERNOR HIGH SPEED CONTROL. . . 2.7655 A
SCREW, GOVERNOR LOAD LIMIT. . . . . . . 2.8180 A
SCREW, GOVERNOR LOW SPEED SPRING ADJUSTING . . . . 2.7550 A
SCREW, HYDRAULIC PUMP VALVE . . . . . . 9.1530 A
SCREW, INJECTOR CONTROL TUBE LEVER. . . 2.9021
SCREW, LOW SPEED STOP . . . . 2.8525 A
SCREW, SELECTOR VALVE LOCATING. . . . . 9.1165 A
SEAL KIT, FORWARD CLUTCH PISTON . . . . 9.1230 A
SEAL KIT, REVERSE CLUTCH PISTON . . . . 9.1035 A
SEAL RING, STARTING AID PUMP PLUNGER. .12.6312 C
SEAL, ACCESSORY DRIVE OIL . . . . 1.7620 B
SEAL, ACCESSORY DRIVE OIL . . . . 1.7660 B
SEAL, AIR COMPRESSOR DRIVE. . . . . . .12.4051 A
SEAL, AIR INLET HOUSING SHUTDOWN VALUE . . . . 3.3055 A
SEAL, AIR INLET HOUSING SHUTDOWN VALVE . . . . 3.3055 A
SEAL, AIR INLET HOUSING SHUTDOWN VALVE SHAFT . . . . 3.3055 A
SEAL, BLOWER DRIVE COVER. 3.4220
SEAL, BLOWER HOUSING END PLATE. 3.4160
SEAL, CAMSHAFT OIL. 1.7060
SEAL, CLUTCH DRIVE SHAFT BEARING GREASE. . . . . 8.1686 A
SEAL, CONTROL VALVE SHUT-OFF. . . . . . 9.1172 A
SEAL, CRANKSHAFT FRONT COVER. . . . . . 1.3166 A
SEAL, CRANKSHAFT OIL - FRONT. 1.3040
SEAL, CRANKSHAFT OIL - REAR 1.3060
SEAL, FAN SHAFT . . . . 5.4150 A
SEAL, FLYWHEEL OIL. . . . . 5.1207 A
SEAL, FORWARD CLUTCH. . . . . 9.1230 A
SEAL, FORWARD CLUTCH PISTON . . . . . . 9.1230 A
SEAL, FRESH WATER PUMP. 5.1130
SEAL, FRESH WATER PUMP SHAFT BEARING OIL. 5.1065
SEAL, FRESH WATER PUMP SHAFT BEARING OIL 5.1065
SEAL, FUEL PUMP OIL 2.2070
SEAL, GEAR BOX OUTPUT SHAFT BEARING OIL . . . . 5.3120 A
SEAL, GENERATOR DRIVE OIL . . . . 7.1515 A
SEAL, GOVERNOR. . . . . 2.7945 A

PART NAME . . . GROUP NO.

SEAL, GOVERNOR DRIVE BEARING. . . . . . 2.8835 A
SEAL, GOVERNOR ROCKER SHAFT OIL . . . . 8.3445 A
SEAL, GOVERNOR SPEED ADJUST TERMINAL SHAFT OIL . . . . 2.8472 A
SEAL, GOVERNOR SPEED ADJUSTING SHAFT OIL . . . . 2.8350 A
SEAL, GOVERNOR SPEED ADJUSTING TERMINAL SHAFT OIL. . . . 2.8472 A
SEAL, GOVERNOR SPEED ADJUSTING SHAFT OIL . . . . 2.8350 A
SEAL, HEAT EXCHANGER. . . . . 5.5026 A
SEAL, HYDRAULIC PUMP DRIVE. . . . . .12.5036 A
SEAL, HYDRAULIC PUMP OIL. . . . . 9.1505 A
SEAL, HYDRAULIC STARTER ACCUMULATOR CAP . . . . .12.6574 D
SEAL, HYDRAULIC STARTER ACCUMULATOR PISTON. . . . .12.6582 D
SEAL, HYDRAULIC STARTER ENGINE PUMP OIL . . . . .12.6003 D
SEAL, OVERSPEED TRIP GOVERNOR HOUSING COVER OIL . . . . 7.4636 C
SEAL, OVERSPEED TRIP GOVERNOR MOUNTING OIL. . . . 7.4644 C
SEAL, POWER TAKE-OFF ADAPTOR HOUSING OIL . . . . 8.1902 A
SEAL, POWER TAKE-OFF ADAPTOR HOUSING OIL . . . . 8.1902 A
SEAL, RAW WATER PUMP BEARING. . . . . 5.6160 A
SEAL, RAW WATER PUMP IMPELLER . . . . . 5.6240 A
SEAL, RAW WATER PUMP SHAFT. . . . . 5.6170 A
SEAL, REDUCTION GEAR BEARING COVER OIL . . . . 9.1375 A
SEAL, REDUCTION GEAR SHAFT OIL. . . . . 8.1950 A
SEAL, REVERSE CLUTCH PISTON . . . . . 9.1035 A
SEAL, REVERSE GEAR DRIVE SHAFT BEARING HOUSING OIL . . . . 9.1130 A
SEAL, REVERSE GEAR OIL DRAIN SLEEVE . . 9.1630 A
SEAL, ROTOR ASSY. SHAFT OIL . . . . . 3.5028 A
SEAL, ROTOR ASSY., SHAFT OIL. . . . . 3.5028 A
SEAL, SELECTOR VALVE OIL. . . . . 9.1160 A
SEAL, TACH. DRIVE ADAPTOR . . . . . 7.4458 B
SEAL, TACHOMETER DRIVE COVER. . . . . 7.4450 B
SEAL, TACHOMETER DRIVE COVER ADAPTOR. . 7.4458 B
SEAL, THERMO FAN ELEMENT. . . . . 5.4375 A
SEAL, THERMOSTAT. . . . . 5.2060 B
SEAL, WATER OUTLET MANIFOLD . . . . . 5.2043 A
SEAT, BLOWER DRIVE COUPLING SPRING. . . 3.4410
SEAT, CONTROL VALVE PRESSURE REGULATOR. . . . . 9.1196 A
SEAT, EXHAUST VALVE SPRING. 1.8360
SEAT, FUEL FILTER ELEMENT . . . . . 2.3322 A
SEAT, GOVERNOR LOW SPEED SPRING . . . . 2.7570 A
SEAT, GOVERNOR SPEEDER SPRING . . . . . 2.8540 A
SEAT, HYDRAULIC STARTER ENGINE PUMP RELIEF VALVE SPRING . . . . .12.6623 D
SEAT, INJECTOR VALVE. . . . . 2.1247 A
SEAT, INJECTOR VALVE SPRING . . . . . 2.1255 A
SEAT, OIL PRESSURE REGULATOR AND RELIEF VALVE. . . . . 4.1701 C
SEAT, PUSH ROD SPRING-LOWER 1.8210
SEAT, PUSH ROD SPRING-UPPER 1.8200
SEAT, RAW WATER PUMP SHAFT SEAL . . . . 5.6173 A
SEPARATOR, BREATHER OIL . . . . . 4.8050 A

PART NAME . . . GROUP NO.

SEPARATOR, FUEL - WATER . . . . . 2.3590 A
SERVICE KIT, INJECTOR . . . . . 2.1002 A
SHAFT & CARRIER ASSY., GOVERNOR WEIGHT. . . . . 2.7350 A
SHAFT ASSY. GOV. OPERATING. . . . . 2.7250 A
SHAFT ASSY., BLOWER AND HYDRAULIC PUMP DRIVE. . . . . 9.1537 A
SHAFT ASSY., CONTROL LINK OPERATING . . 2.8811 A
SHAFT ASSY., FRESH WATER PUMP 5.1050
SHAFT ASSY., GOV. OPERATING . . . . . 2.7250 A
SHAFT ASSY., GOV. THROTTLE. . . . . 2.8979 A
SHAFT ASSY., GOVERNOR DRIVEN. . . . . 2.8790 A
SHAFT ASSY., GOVERNOR LINK OPERATING. . 2.8811 A
SHAFT ASSY., GOVERNOR SHUTDOWN. . . . . 2.7115 A
SHAFT ASSY., GOVERNOR THROTTLE. . . . . 2.7095 A
SHAFT ASSY., REVERSE GEAR DRIVE . . . . 9.1100 A
SHAFT ASSY., ROCKER 1.8160
SHAFT ASSY., TACHOMETER DRIVE FLEXIBLE. . . . . 7.4405 B
SHAFT ASSY., TACHOMETER DRIVE FLEX FLEXIBLE. . . . . 7.4405 B
SHAFT ASSY., TURBINE. . . . . 3.5033 A
SHAFT, ACCESSORY DRIVE. . . . . 1.7640 B
SHAFT, AIR COMPRESSOR DRIVE . . . . . .12.4047 A
SHAFT, AIR INLET HOUSING SHUTDOWN . . . 3.3050 A
SHAFT, AIR INLET HSG. SHUTDOWN. . . . . 3.3050 A
SHAFT, AUTOMATIC STARTING GEAR AND CAM . . . . . 7.2262 B
SHAFT, AUTOMATIC STARTING MOUNTING. . . 7.2275 B
SHAFT, BLOWER DRIVE . . . . . 3.4445 A
SHAFT, BLOWER ROTOR 3.4035
SHAFT, CLUTCH DRIVE . . . . . 8.1670 A
SHAFT, CLUTCH RELEASE . . . . . 8.1270 A
SHAFT, EXHAUST RESTRICTOR VALVE . . . . 6.2139 A
SHAFT, FAN. . . . . 5.4100 A
SHAFT, FAN (FOR CUSTOMER FURNISHED BRACKET). . . . . 5.4100 A
SHAFT, FUEL PUMP. 2.2093
SHAFT, FUEL PUMP DRIVEN 2.2089
SHAFT, GEAR BOX OUTPUT. . . . . 9.3042 A
SHAFT, GOVERNOR CONTROL EQUALIZER . . . 2.9025
SHAFT, GOVERNOR DRIVE . . . . . 2.8795 A
SHAFT, GOVERNOR DRIVE . . . . . 2.8820 A
SHAFT, GOVERNOR DRIVE . . . . . 8.3085 A
SHAFT, GOVERNOR DRIVE (FLEXIBLE). . . . 2.8025 A
SHAFT, GOVERNOR DRIVEN. . . . . 2.8795 A
SHAFT, GOVERNOR OPERATING . . . . . 2.7255 A
SHAFT, GOVERNOR ROCKER. . . . . 8.3435 A
SHAFT, GOVERNOR SPEED ADJUSTING . . . . 2.8280 A
SHAFT, GOVERNOR SPEED ADJUSTING . . . . 8.3470 A
SHAFT, GOVERNOR SPEED ADJUSTING TERMINAL. . . . . 2.8470 A
SHAFT, GOVERNOR VARIABLE SPEED SPRING LEVER. . . . . 2.7720 A
SHAFT, GOVERNOR WEIGHT CARRIER. . . . . 2.7360 A
SHAFT, HYDRAULIC PUMP . . . . . 9.1510 A
SHAFT, HYDRAULIC PUMP DRIVE . . . . . .12.5027 A
SHAFT, HYDRAULIC STARTER. . . . . .12.6532 D
SHAFT, HYDRAULIC STARTER CONTROL. . . .12.6512 D
SHAFT, HYDRAULIC STARTER ENGINE PUMP. . . . . .12.6600 D
SHAFT, INJECTOR CONTROL TUBE END. . . . 2.9007
SHAFT, OIL PUMP DRIVE . . . . . 4.1070 A

PART NAME . . . . GROUP NO.

SHAFT, OIL PUMP DRIVEN GEAR . . . . 4.1080 A
SHAFT, OVERSPEED & LOW OIL PRESSURE VALVE DRIVE-FLEXIBLE. . . . . 7.4606 C
SHAFT, OVERSPEED TRIP GOVERNOR OPERATING . . . . 7.4646 C
SHAFT, OVERSPEED VALVE DRIVE FLEXIBLE. . . . . 7.4589 C
SHAFT, PLANETARY GEAR PINION. . . . . . . 9.1084 A
SHAFT, POWER TAKE-OFF ADAPTOR STUD. . . 8.1904 A
SHAFT, PROPELLER DRIVE OUTPUT . . . . . 9.3465 A
SHAFT, RAW WATER PUMP . . . . 5.6120 A
SHAFT, REDUCTION GEAR . . . . 8.1935 A
SHAFT, REDUCTION GEAR DRIVE . . . . . . 9.1340 A
SHAFT, REVERSE GEAR PINION DRIVE. . . . 9.1300 A
SHAFT, STARTER DRIVE. . . . . .12.6045 A
SHAFT, TACHOMETER DRIVE 3.4038
SHAFT, TACHOMETER DRIVE . . . . 7.4435 B
SHAFT, THERMO FAN DRIVE . . . . 5.4360 A
SHAFT, THROTTLE CONTROL . . . . 2.9360 A
SHAFT, THROTTLE CONTROL (TO GOVERNOR) . . . . 2.9360 A
SHAFT, THROTTLE CONTROL (TO GOV.) . . . 2.9360 A
SHAFT, THROTTLE CONTROL (TO GOVERNOR) . . . . 2.9360 A
SHAFT, THROTTLE CONTROL CROSS . . . . . 2.9310 A
SHAFT, THROTTLE CONTROL CROSS . . . . . 2.9680 A
SHAFT, THROTTLE CONTROL KNOB. . . . . . 2.9106 A
SHAFT, THROTTLE CONTROL LEVER BRACKET . . . . 2.9590 A
SHAFT, THROTTLE CONTROL SHAFT STUB. . . 2.9200 A
SHAFT, VERNIER THROTTLE CONTROL . . . . 2.9140 A
SHAFT,.ACCESSORY DRIVE. . . . . 1.7640 B
SHELL ASSY., OIL COOLER TUBE TYPE . . . 4.4003 A
SHELL ASSY., RADIATOR . . . . 5.3015 A
SHELL, BREATHER . . . . 4.8055 A
SHELL, CONNECTING ROD BEARING 1.6100
SHELL, CONVERTER OIL FILTER . . . . . . 8.3874 B
SHELL, CRANKSHAFT MAIN BEARING. 1.3090
SHELL, DRAIN TANK . . . . 1.1170 A
SHELL, FUEL FILTER. . . . . 2.3380 A
SHELL, FUEL STRAINER (PRIMARY). . . . . 2.3050 A
SHELL, HYDRAULIC STARTER ACCUMULATOR . . . . .12.6572 D
SHELL, OIL FILTER . . . . 4.2280 A
SHELL, OIL FILTER . . . . 8.1976 A
SHELL, OIL FILTER . . . . 9.1781 A
SHELL, OIL STRAINER . . . . 9.1670 A
SHIELDING, FLEXIBLE HOSE. 2.5255
SHIELDING, FLEXIBLE HOSE. . . . . 2.5255 A
SHIM SET, TURBOCHARGER EXHAUST HOUSING . . . . 3.5010 A
SHIM, BILGE PUMP SHAFT BEARING. . . . .12.2110 A
SHIM, BLOWER ROTOR GEAR 3.4090
SHIM, CYLINDER LINER. 1.6185
SHIM, ENGINE SUPPORT. . . . . .11.1080 A
SHIM, GOVERNOR VARIABLE SPEED SPRING. . 2.7800 A
SHIM, OIL PUMP. . . . . 4.1030 A
SHIM, PILLOW BLOCK. . . . . 8.1820 A
SHIM, SET TURBO EXHAUST HOUSING . . . . 3.5010 A
SHIM, TORQUE CONVERTER SUPPORT. . . . . 8.3275 A
SHROUD, FAN . . . . 5.4560 B
SILENCER, AIR . . . . 3.2001 A

PART NAME . . . . GROUP NO.

SLEEVE ASSY., GOVERNOR SPEED ADJUSTING TERMINAL. . . . . 2.8480 A
SLEEVE, CLUTCH RELEASE. . . . . 8.1285 A
SLEEVE, CRANKSHAFT REAR OIL SEAL. . . . 1.3066
SLEEVE, GOVERNOR DRIVEN SHAFT . . . . . 2.8800 A
SLEEVE, GOVERNOR RELIEF VALVE . . . . . 2.8660 A
SLEEVE, GOVERNOR SPEED ADJUSTING SHAFT . . . . 2.8360 A
SLEEVE, OUTPUT SHAFT REAR BEARING OIL SEAL. . . . . 9.3125 A
SLEEVE, OVERSPEED VALVE ADJUSTING . . . 7.4739 C
SLEEVE, REVERSE GEAR HOUSING OIL TRANSFER. . . . . 9.1020 A
SLEEVE, REVERSE GEAR OIL DRAIN. . . . . 9.1625 A
SLINGER, CRANKSHAFT OIL - FRONT 1.3050
SLINGER, RAW WATER PUMP SHAFT . . . . . 5.6200 A
SLINGER, REDUCTION GEAR DRIVE SHAFT THRUST BEARING OIL. . . . . 9.1355 A
SLINGER, TACHOMETER DRIVE SHAFT OIL . . . . 7.4440 B
SLINGER, TACHOMETER DRIVE SHAFT OIL . . 7.4440 B
SOLENOID, AIR SHUT-OFF. . . . . 7.4519 C
SOLENOID, AIR SHUTOFF . . . . 7.4519 C
SOLENOID, AUTOMATIC STARTING. . . . . . 7.2225 B
SOLENOID, THROTTLE CONTROL. . . . . . . 2.9355 A
SPACER ASSY., IDLER GEAR HOLE 1.7260
SPACER, ACCESSORY DRIVE BEARING . . . . 1.7652 B
SPACER, ACCESSORY DRIVE OIL SEAL. . . . 1.7665 B
SPACER, AIR CLEANER BRACKET . . . . . . 3.1240 A
SPACER, BLOWER ROTOR FUEL PUMP COUPLING DISC 3.4112
SPACER, BLOWER ROTOR SHAFT OIL SEAL . . 3.4163
SPACER, CAMSHAFT GEAR 1.7202
SPACER, CLUTCH DRIVE SHAFT BEARING RETAINER. . . . . 8.1695 A
SPACER, CRANKSHAFT FRONT OIL SEAL . . . 1.3055
SPACER, CRANKSHAFT REAR OIL SEAL. . . . 1.3065
SPACER, ENGINE FRONT SUPPORT. . . . . .11.1073 A
SPACER, FAN SHAFT BEARING . . . . 5.4170 A
SPACER, FRESH WATER PUMP BEARING. . . . 5.1060
SPACER, FUEL SUPPLY TO STRAINER TUBE CLIP. . . . . 2.5040 A
SPACER, GEN. ADJUSTING STRAP. . . . . . 7.1581 A
SPACER, GENERATOR ADJUSTING STRAP . . . 7.1581 A
SPACER, GENERATOR AND MOUNTING BRACKET . . . . 7.1598 A
SPACER, GENERATOR DRIVE BELT & PULLEY GUARD. . . . . 7.1590 A
SPACER, GENERATOR DRIVE BELT AND PULLEY GUARD. . . . . 7.1590 A
SPACER, GENERATOR DRIVE PULLEY BEARING SHAFT . . . . 7.1540 A
SPACER, GENERATOR DRIVE PULLEY SHAFT BEARING . . . . 7.1540 A
SPACER, GENERATOR DRIVE PULLEY SHAFT BEARING . . . . 7.1540 A
SPACER, GENERATOR DRIVEN PULLEY . . . . 7.1503 A
SPACER, GOV. TO CYLINDER HEAD . . . . . 2.7030 A
SPACER, GOVERNOR TO CYLINDER HEAD . . . 2.7030 A
SPACER, INJECTOR CONTROL TUBE LEVER . . 2.9010
SPACER, OIL FILTER. . . . . 4.2270 A
SPACER, OIL FILTER MOUNTING . . . . . . 4.2460 A
SPACER, OIL PUMP BODY . . . . 4.1060 A

PART NAME GROUP NO.

SPACER, RAW WATER PUMP BEARING 5.6135 A
SPACER, RAW WATER PUMP DRIVE 5.6450 A
SPACER, REDUCTION GEAR PINION BEARING 9.1335 A
SPACER, STARTER DRIVE SHAFT 12.6050 A
SPACER, TURBOCHARGER ROTOR THRUST 3.5035 A
SPACER, VIBRATION DAMPER 1.3275 B
SPACER, GENERATOR AND MOUNTING BRACKET 7.1597 A
SPIDER AND SHAFT ASSY., GOVERNOR OPERATING 8.3400 A
SPRING, AIR HEATER 7.8153 A
SPRING, AIR HEATER FILTER 7.8070 A
SPRING, AIR INLET HOUSING 3.3070 A
SPRING, AIR INLET HOUSING SHUTDOWN VALVE 3.3070 A
SPRING, AIR INLET HOUSING SHUTDOWN VALVE TENSION 3.3070 A
SPRING, AIR SHUTOFF RESET LATCH 7.4560 C
SPRING, AUTOMATIC STARTING CONTACT 7.2287 B
SPRING, AUTOMATIC STARTING RETURN 7.2267 B
SPRING, AUTOMATIC STARTING SOLENOID ROD 7.2252 B
SPRING, BLOWER DRIVE COUPLING 3.4400
SPRING, CLUTCH PRESSURE PLATE RETURN 8.1135 A
SPRING, CLUTCH TOGGLE LEVER 8.1100 A
SPRING, CONTROL VALVE PRESSURE REGULATOR RELIEF VAL. 9.1195 A
SPRING, EXHAUST VALVE 1.8340
SPRING, FAST IDLE AIR CLEANER 2.7870 A
SPRING, FAST IDLE AIR CYLINDER 2.7870 A
SPRING, FLEXIBLE COUPLING DAMPER 1.4065 A
SPRING, FLEXIBLE SHAFT CASING 12.8512 B
SPRING, FORWARD CLUTCH 9.1270 A
SPRING, FORWARD CLUTCH DISC PLATE 9.1237 A
SPRING, FORWARD CLUTCH DUMP VALVE 9.1270 A
SPRING, FORWARD CLUTCH RELEASE 9.1240 A
SPRING, FUEL FILTER ELEMENT 2.3370 A
SPRING, FUEL PUMP VALVE RETAINING 2.2160
SPRING, FUEL STRAINER (PRIMARY) 2.3060 A
SPRING, GOVERNOR CONTROL RETRACTING 2.9405 A
SPRING, GOVERNOR FUEL ROD LONG 2.8130 A
SPRING, GOVERNOR FUEL ROD SHORT 2.8120 A
SPRING, GOVERNOR HIGH SPEED 2.7550 A
SPRING, GOVERNOR LEVER RETRACTING 2.7210 A
SPRING, GOVERNOR LOW SPEED 2.7540 A
SPRING, GOVERNOR RELIEF VALVE 2.8680 A
SPRING, GOVERNOR SHUTDOWN SHAFT 2.7117 A
SPRING, GOVERNOR SPEED ADJUSTING 8.3465 A
SPRING, GOVERNOR SPEEDER 2.8530 A
SPRING, GOVERNOR THROTTLE SHAFT ARM RETURN 2.7093 A
SPRING, GOVERNOR VARIABLE SPEED 2.7760 A
SPRING, HYDRAULIC PUMP VALVE 9.1525 A
SPRING, HYDRAULIC STARTER CONTROL SHAFT TORSION 12.6513 D
SPRING, HYDRAULIC STARTER ENGINE PUMP PISTON 12.6608 D
SPRING, HYDRAULIC STARTER ENGINE PUMP RELIEF VALVE 12.6622 D
SPRING, INJECTOR CONTROL EQUALIZER 2.9008
SPRING, INJECTOR CONTROL TUBE 2.9012
SPRING, INJECTOR FILTER 2.1120 A
SPRING, INJECTOR PLUNGER 2.1080 A
SPRING, INJECTOR VALVE 2.1250 A
SPRING, OIL COOLER BY-PASS VALVE 4.4150 A
SPRING, OIL FILTER 4.2310 A
SPRING, OIL FILTER 8.1979 A
SPRING, OIL FILTER 8.3879 B
SPRING, OIL FILTER 9.1786 A
SPRING, OIL FILTER BY-PASS 4.2486 A
SPRING, OIL FILTER BY-PASS 9.1797 A
SPRING, OIL FILTER BY-PASS VALVE 4.2486 A
SPRING, OIL FILTER BY-PASS VALVE 8.1584 A
SPRING, OIL FILTER PRESSURE REGULATOR 8.3886 B
SPRING, OIL FILTER TUBE ADAPTOR BY-PASS VALVE 4.3057 A
SPRING, OIL PRESSURE REGULATOR 4.1650 C
SPRING, OIL PUMP RELIEF VALVE 4.1260 A
SPRING, OPERATING LEVER RETURN 2.8955 A
SPRING, OVERSPEED TRIP 7.4651 C
SPRING, OVERSPEED TRIP GOVERNOR 7.4651 C
SPRING, OVERSPEED VALVE PISTON 7.4737 C
SPRING, PUSH ROD 1.8190
SPRING, RAW WATER PUMP SHAFT SEAL 5.6178 A
SPRING, REVERSE CLUTCH RELEASE 9.1055 A
SPRING, SELECTOR VALVE POPPET 9.1150 A
SPRING, SPEED ADJUSTING SHAFT TORSION 2.8355 A
SPRING, STARTER HANDLE RETURN 12.6821 F
SPRING, THROTTLE BOOSTER 2.9347 A
SPRING, THROTTLE CONTROL LEVER 2.9645 A
SPRING, THROTTLE CONTROL SHAFT TENSION 2.9108 A
SPRING, VERNIER THROTTLE CONTROL LOCK 2.9138 A
SPRING, VERNIER THROTTLE CONTROL LOCK BUTTON PIN 2.9147 A
SPRING, WATER FILTER 5.7026 A
SPROCKET, BLOWER ROTOR GEAR DRIVE 3.4103
SPROCKET, BLOWER ROTOR GEAR DRIVE 3.4103
SPROCKET, BLOWER ROTOR GEAR DRIVE 3.4105
SPROCKET, BLOWER ROTOR GEAR DRIVEN 3.4105
STABILIZER KIT, MAIN BEARING CAP 1.3115
STABILIZER, CRANKSHAFT MAIN BEARING CAP 1.3112
STAKING AND SWAGING TOOL FLEXIBLE SHAFT 12.8518 B
STARTER ASSY., ENGINE DRIVE 12.6020 A
STARTER ASSY., HYDRAULIC 12.6501 D
STARTING AID KIT, COLD WEATHER 12.6301 C
STOP, AUTOMATIC STARTING CAM 7.2285 B
STOP, GOVERNOR VARIABLE SPEED SPRING 2.7795 A
STOP, INJECTOR VALVE 2.1260 A
STRAINER & PLUG ASSY., STARTING FULID 12.6385 C
STRAINER ASSY., CONVERTER OIL 8.3816 B
STRAINER ASSY., FUEL 2.3001 A
STRAINER ASSY., OIL (MARINE GEAR) 9.1650 A
STRAINER ASSY., OIL (MARINE GEAR) 9.1650 A
STRAINER, AIR COMPRESSOR 12.4300 A
STRAINER, FUEL TANK HOSE 2.6007 A
STRAINER, OIL FILLER 4.5020 A

PART NAME	GROUP NO.
STRAP, ACCUMULATOR MOUNTING	12.6682 D
STRAP, AIR CLEANER MOUNTING	3.1220 A
STRAP, AIR SILENCER MOUNTING	3.2014 A
STRAP, ENGINE TO BASE GROUND	7.7110 A
STRAP, EXHAUST MUFFLER MOUNTING	6.2010 A
STRAP, EXHAUST MUFFLER MTG.	6.2010 A
STRAP, FUEL FILTER MOUNTING	2.3503 A
STRAP, FUEL STRAINER MOUNTING	2.3165 A
STRAP, FUEL TANK	2.6065 A
STRAP, GENERATOR ADJUSTING	7.1580 A
STRAP, HYDRAULIC PUMP ADJUSTING	12.5022 A
STRAP, HYDRAULIC STARTER RESERVOIR	12.6552 D
STRAP, STARTING MOTOR GROUND	7.3242 A
STRIP, RADIATOR TANK MOUNTING	5.3050 A
STUD, BILGE PUMP BODY	12.2020 A
STUD, BILGE PUMP SHAFT PACKING GLAND	12.2080 A
STUD, CYLINDER HEAD	1.2030
STUD, EXHAUST MANIFOLD	6.1020 A
STUD, EXHAUST MANIFOLD COVER PLATE	6.1120 A
STUD, EXHAUST MANIFOLD OUTLET	6.1050 A
STUD, EXHAUST MANIFOLD WATER OUTLET FLANGE	6.1160 A
STUD, EXHAUST OUTLET	6.2115 A
STUD, FRESH WATER PUMP BODY	5.1040
STUD, GOVERNOR OIL PUMP DRIVEN GEAR TO BASE	2.8740 A
STUD, OIL FILTER CENTER	4.2410 A
STUD, OIL FILTER CENTER	8.1982 A
STUD, OIL FILTER CENTER	9.1789 A
STUD, ROCKER COVER	1.8475 A
STUD, WATER OUTLET MANIFOLD	5.2020 A
SUB-CAP ASSY., GOVERNOR	2.8050 A
SUMP, OIL PAN	4.7140 A
SUMP, REDUCTION GEAR OIL	9.1385 A
SUPPORT, AIR SILENCER	3.2010 A
SUPPORT, AUTOMATIC STARTING GEAR AND CAM BRACKET	7.2273 B
SUPPORT, BLOWER DRIVE COUPLING	3.4380
SUPPORT, BLOWER DRIVE GEAR HUB	3.4350
SUPPORT, ENGINE FRONT	11.1070 A
SUPPORT, ENGINE FRONT TRUNNION MOUNTING	11.1090 A
SUPPORT, ENGINE REAR	11.1100 A
SUPPORT, FAN MOUNTING	5.4025 A
SUPPORT, FRESH WATER PUMP BEARING	5.1072
SUPPORT, GENERATOR ADJUSTING STRAP	7.1583 A
SUPPORT, GENERATOR ADJUSTING STRAP BRACKET	7.1583 A
SUPPORT, GENERATOR BRACKET	7.1596 A
SUPPORT, INSTRUMENT PANEL	7.4013 A
SUPPORT, OIL FILTER MOUNTING	4.2470 A
SUPPORT, OIL FILTER MOUNTING	8.3982 B
SUPPORT, PILLOW BLOCK	8.1830 A
SUPPORT, POWER TAKE-OFF	8.1895 A
SUPPORT, RAW WATER PUMP	5.6005 A
SUPPORT, THROTTLE CONTROL BELL CRANK	2.9700 A
SUPPORT, TORQUE CONVERTER	8.3270 A
SWITCH, AIR HEATER	7.8380 A
SWITCH, AIR PRESSURE	7.4503 C
SWITCH, AIR SHUTOFF SOLENOID LIMIT	7.4522 C
SWITCH, ALARM SHUT-OFF	7.4598 C
SWITCH, ALARM SHUTOFF	7.4598 C
SWITCH, AUTOMATIC STARTING LIMIT	7.2280 B
SWITCH, AUTOMATIC STARTING SELECTOR	7.2350 B
SWITCH, ENGINE STARTING	7.4115 A
SWITCH, OIL PRESSURE	7.4125 A
SWITCH, OIL PRESSURE	7.4586 C
SWITCH, OVERSPEED TRIP GOVERNOR	7.4659 C
SWITCH, SHUTDOWN SOLENOID MICRO	7.4520 C
SWITCH, STARTING MOTOR SOLENOID	7.3255 A
SWITCH, STARTING MOTOR SOLENOID OR THROTTLE	7.2440 B
SWITCH, WATER HEATER CONTROL	12.6405 C
SWITCH, WATER TEMPERATURE	7.4128 A
SWITCH, WATER TEMPERATURE	7.4505 C

T

PART NAME	GROUP NO.
TACHOMETER	7.4060 A
TANK & STRAINER ASSY., STARTING AID	12.6355 C
TANK ASSY., AIR BOX AND FUEL PUMP DRAIN	1.1150 A
TANK ASSY., FUEL	2.6001 A
TANK, COOLANT DE-AERATION	4.3282 A
TANK, COOLANT DE-AERATION	5.3282 B
TANK, EXPANSION	5.5001 A
TANK, RADIATOR - LOWER	5.3030 A
TANK, RADIATOR - UPPER	5.3020 A
THE FOLLOWING ITEMS ARE SHIPPED	1.2001
THERMOSTAT	5.2050 B
TIP ASSY., INJECTOR SPRAY	2.1235 A
TIP KIT, INJECTOR SPRAY	2.1220 A
TIP, FLEXIBLE SHAFT LOWER	12.8506 B
TIP, FLEXIBLE SHAFT UPPER	12.8508 B
TIP, INJECTOR SPRAY	2.1230 A
TRANSFORMER, POWER GENERATOR CURRENT	7.6785 A
TRANSFORMER, POWER GENERATOR POTENTIAL	7.6780 A
TRANSFORMER, POWER GENERATOR CURRENT	7.6785 A
TROUGH, GEAR BOX OIL	9.3215 A
TRUNNION, ENGINE FRONT	11.1088 A
TUBE & ELBOW ASSY., AIR COMPRESSOR BOOSTER INLET	12.4375 A
TUBE AND ELBOW ASSY., AIR COMPRESSOR BOOSTER INLET	12.4375 A
TUBE AND ELBOW ASSY., AIR COMPRESSOR BOOSTER INLET	12.4375 A
TUBE AND LEVER ASSY., INJECTOR CONTROL	2.9000
TUBE AND LEVER ASSY., INJECTOR CONTROL	2.9001
TUBE ASSY., OIL PAN DRAIN	4.7100 A
TUBE ASSY., RAW WATER PUMP OUTLET	5.6580 A
TUBE ASSY., WATER PUMP TO WATER MANIFOLD VENT	5.1003
TUBE, ACCESSORY DRIVE OIL SUPPLY	1.7647.B
TUBE, AIR BOX DRAIN	1.1100 A B
TUBE, AIR COMPRESSOR LUBE OIL SUPPLY	12.4065 A
TUBE, AIR COMPRESSOR LUBE OIL DRAIN	12.4070 A
TUBE, AIR COMPRESSOR LUBE OIL SUPPLY	12.4065 A
TUBE, AIR COMPRESSOR OIL DRAIN	12.4070 A

PART NAME GROUP NO.

TUBE, AIR COMPRESSOR OIL LUBE OIL DRAIN . . . 12.4070 A
TUBE, AIR COMPRESSOR OIL SUPPLY . . . 12.4065 A
TUBE, AIR COMPRESSOR WATER CROSSOVER . . . 12.4087 A
TUBE, AIR COMPRESSOR WATER CROSSOVER . . . 12.4087 A
TUBE, AIR COMPRESSOR WATER INLET . . . 12.4085 A
TUBE, AIR COMPRESSOR WATER OUTLET . . . 12.4090 A
TUBE, AIR HEATER INLET (PUMP OUTLET) . . . 7.8310 A
TUBE, AIR HEATER PUMP INLET . . . 7.8300 A
TUBE, AIR INLET HOUSING TO CONTROLLER . . . 3.5725 A
TUBE, AUXILIARY FUEL PRIMER PUMP TO FUEL TANK . . . 2.5420 A
TUBE, AUXILIARY FUEL PUMP TO PRIMER PUMP . . . 2.5410 A
TUBE, CONVERTER TANK TO PUMP . . . 8.3820 B
TUBE, CONVERTER TO FILTER . . . 8.3827 B
TUBE, CONVERTER TO TANK . . . 8.3830 B
TUBE, CYLINDER HEAD AIR INLET . . . 4.8120 A
TUBE, CYLINDER HEAD VENT . . . 5.3480 B
TUBE, DRAIN TANK RETAINER . . . 1.1190 A
TUBE, ENGINE FRONT TRUNNION BEARING LUBRICATING . . . 11.1092 A
TUBE, EXHAUST CROSSOVER . . . 6.1180 A
TUBE, EXHAUST MANIFOLD WATER OUTLET . . . 7.4699 C
TUBE, EXHAUST MANIFOLD WATER INLET . . . 7.4694 C
TUBE, EXHAUST MANIFOLD WATER OUTLET . . . 7.4699 C
TUBE, EXPANSION TANK OVERFLOW . . . 5.5190 A
TUBE, FILTER TO CYLINDER HEAD . . . 2.5149 A
TUBE, FILTER TO OIL COOLER . . . 8.3828 B
TUBE, FUEL COOLER . . . 2.5214 A
TUBE, FUEL DRAIN . . . 2.5210 A
TUBE, FUEL DRAIN . . . 2.5215 A
TUBE, FUEL DRAIN (RETURN) . . . 2.5210 A
TUBE, FUEL DRAIN CROSSOVER . . . 2.5205 A
TUBE, FUEL DRAIN FLEXIBLE . . . 2.5215 A
TUBE, FUEL FILTER TO CYLINDER HEAD . . . 2.5149 A
TUBE, FUEL PUMP INLET . . . 2.5060 A
TUBE, FUEL PUMP TO FILTER . . . 2.5100 A
TUBE, FUEL STRAINER TO FUEL PUMP . . . 2.5050 A
TUBE, FUEL SUPPLY CROSSOVER . . . 2.5163 A
TUBE, FUEL SUPPLY TO STRAINER . . . 2.5001 A
TUBE, FUEL SUPPLY TO STRAINER . . . 2.5010 A
TUBE, FUEL SUPPLY TO STRAINER (FLEXIBLE) . . . 2.5010 A
TUBE, FUEL SUPPLY TO STRAINER FLEXIBLE . . . 2.5010 A
TUBE, FUEL SUPPLY TO STRAINER FLEXIBLE . . . 2.5010 A
TUBE, GEAR BOX TO OIL STRAINER . . . 9.1730 A
TUBE, GOV. OPERATING PRESSURE . . . 2.8910 A
TUBE, GOVERNOR CONTROL EQUALIZER SHAFT . . . 2.9027
TUBE, GOVERNOR OPERATING PRESSURE . . . 2.8910 A
TUBE, HEAT EXCHANGER FRESH WATER OUTLET . . . 5.3425 B
TUBE, HEAT EXCHANGER INLET (INTERMEDIATE) . . . 5.5430 A
TUBE, HEAT EXCHANGER RAW WATER INLET INTERMEDIATE . . . 5.6583 A
TUBE, HEAT EXCHANGER WATER INLET . . . 5.5440 A
TUBE, HEAT EXCHANGER WATER INLET . . . 5.6585 A
TUBE, HEAT EXCHANGER WATER OUTLET . . . 5.5550 A
TUBE, HYDRAULIC MARINE GEAR OIL STRAINER TO PUMP . . . 9.1720 A
TUBE, HYDRAULIC PUMP DRIVE OIL SUPPLY . . . 12.5034 A
TUBE, HYDRAULIC STARTER ACCUMULATOR TO HYDRAULIC STARTER . . . 12.6860 E
TUBE, HYDRAULIC STARTER ENGINE PUMP TO ACCUMULATOR . . . 12.6850 E
TUBE, HYDRAULIC STARTER HAND PLUMP TO ACCUMULATOR . . . 12.6855 E
TUBE, INTERCOOLER BY-PASS . . . 5.5740 A
TUBE, INTERCOOLER INLET . . . 5.5730 A
TUBE, INTERCOOLER OUTLET . . . 5.5735 A
TUBE, INTERCOOLER WATER RETURN . . . 3.5428 A
TUBE, INTERCOOLER WATER SUPPLY . . . 3.5427 A
TUBE, JUNCTION BLOCK INLET . . . 4.1581 B
TUBE, MARINE GEAR TO OIL STRAINER . . . 4.4350 A
TUBE, MARINE GEAR TO OIL STRAINER . . . 9.1730 A
TUBE, OIL COOLER BY-PASS . . . 4.4176 A
TUBE, OIL COOLER TO CONVERTER TANK . . . 8.3825 B
TUBE, OIL FILLER . . . 4.5001 A
TUBE, OIL FILTER . . . 8.1990 A
TUBE, OIL FILTER INLET . . . 4.3001 A
TUBE, OIL FILTER OUTLET . . . 4.3020 A
TUBE, OIL PRESSURE GAGE . . . 4.1597 B
TUBE, OIL PRESSURE GAGE . . . 4.4340 A
TUBE, OIL PRESSURE GAGE . . . 7.4074 A
TUBE, OIL PRESSURE GAGE . . . 9.1775 A
TUBE, OIL PRESSURE SWITCH . . . 7.4596 C
TUBE, OIL PRESSURE SWITCH RETURN . . . 7.4597 C
TUBE, OVERSPEED TRIP GOVERNOR OIL SUPPLY . . . 7.4668 C
TUBE, OVERSPEED VALVE OIL SUPPLY . . . 7.4746 C
TUBE, PRESSURE SWITCH . . . 7.4596 C
TUBE, PRESSURE SWITCH RETURN . . . 7.4597 C
TUBE, PUMP TO FILTER . . . 2.5100 A
TUBE, RAW WATER PUMP INLET . . . 5.5377 A
TUBE, RAW WATER PUMP OUTLET . . . 5.5380 A
TUBE, REDUCTION GEAR OIL FILLER . . . 9.1410 A
TUBE, REVERSE GEAR LUBE OIL . . . 9.1586 A
TUBE, REVERSE GEAR OIL INLET . . . 9.1585 A
TUBE, REVERSE GEAR OIL OUTLET . . . 9.1595 A
TUBE, SELECTOR VALVE INLET . . . 9.1154 A
TUBE, SOLENOID VALVE . . . 7.4573 C
TUBE, SOLENOID VALVE . . . 7.4673 C
TUBE, STARTING AID PUMP TO NOZZLE . . . 12.6370 C
TUBE, STARTING AID TANK TO PUMP . . . 12.6365 C
TUBE, STRAINER TO FUEL PRIMER PUMP . . . 2.5055 A
TUBE, STRAINER TO FUEL PUMP . . . 2.5050 A
TUBE, THERMOSTAT HOUSING VENT . . . 5.2135 B
TUBE, TURBOCHARGER OIL RETURN . . . 3.5505 A
TUBE, TURBOCHARGER OIL SUPPLY . . . 3.5500 A
TUBE, TURBOCHARGER TO CONTROLLER AIR . . . 3.5720 A
TUBE, WATER BY-PASS . . . 5.2160 C
TUBE, WATER CROSSOVER . . . 5.3470 B
TUBE, WATER HEATER OUTLET . . . 12.6408 C
TUBE, WATER HEATER SUPPLY . . . 12.6407 C
TUBE, WATER PUMP VENT . . . 5.3485 B
TURBOCHARGER . . . 3.5001 A
TURBOCHARGER ASSY . . . 3.5001 A

PART NAME GROUP NO.

V

VALVE ASSY., AIR HEATER PUMP SUPPLY SHUT-OFF. . . . . 7.8295 A
VALVE ASSY., AIR SHUTDOWN . . . . 3.3035 A
VALVE ASSY., AIR STARTER. . . . . .12.6130 B
VALVE ASSY., EXHAUST RESTRICTOR . . . . 6.2130 A
VALVE ASSY., FUEL PUMP CHECK. 2.2035
VALVE ASSY., GOVERNOR CHECK . . . . . . 2.8515 A
VALVE ASSY., GOVERNOR RELIEF. . . . . . 2.8630 A
VALVE ASSY., HYDRAULIC STARTER CONTROL . . . . .12.6516 D
VALVE ASSY., HYDRAULIC STARTER RELIEF. . . . . .12.6970 E
VALVE ASSY., HYDRAULIC STARTER RELIEF . . . . .12.6970 E
VALVE ASSY., INJECTOR . . . . 2.1240 A
VALVE ASSY., MASTER CYLINDER OPERATING . . . . .12.6816 E
VALVE ASSY., OIL COOLER BY-PASS . . . . 4.4120 A
VALVE ASSY., OVERSPEED. . . . . 7.4725 C
VALVE ASSY., OVERSPEED AND LOW OIL PRESSURE. . . . . 7.4591 C
VALVE ASSY., SELECTOR . . . . 9.1135 A
VALVE KIT, GOVERNOR RELIEF. . . . . . . 2.8635 A
VALVE KIT, INJECTOR . . . . 2.1238 A
VALVE, AIR CYLINDER CONTROL . . . . . . 2.9859 A
VALVE, AIR INLET HOUSING SHUTDOWN . . . 3.3040 A
VALVE, AIR INLET HSG. SHUTDOWN. . . . . 3.3040 A
VALVE, CONTROL VALVE PRESSURE REGULATOR RELIEF. . . . . 9.1194 A
VALVE, EXHAUST. 1.8310
VALVE, EXHAUST RESTRICTOR . . . . 6.2136 A
VALVE, FORWARD CLUTCH DUMP. . . . . . . 9.1265 A
VALVE, FUEL PUMP. 2.2130
VALVE, FUEL STRAINER REGULATOR. . . . . 2.3220 A
VALVE, FUEL SUPPLY CHECK. . . . . 2.5006 A
VALVE, FUEL SYSTEM SHUT-OFF . . . . . . 2.5260 A
VALVE, GOVERNOR OPERATING SOLENOID. . . 2.8915 A
VALVE, HYDRAULIC PUMP . . . . 9.1520 A
VALVE, HYDRAULIC PUMP RELIEF. . . . . .12.5070 A
VALVE, HYDRAULIC STARTER ACCUMULATR PRESSURE RELIEF . . . . .12.6583 D
VALVE, HYDRAULIC STARTER ENGINE PUMP CHECK. . . . . .12.6615 D
VALVE, HYDRAULIC STARTER ENGINE PUMP RELIEF . . . . .12.6620 D
VALVE, HYDRAULIC STARTER HAND PUMP CHECK . . . . .12.6640 D
VALVE, HYDRAULIC STARTER HAND PUMP RELIEF. . . . . .12.6635 D
VALVE, HYDRAULIC STARTERCONTROL . . . .12.6518 D
VALVE, HYDRAULIC STRTER ACCUMULATOR . . . . .12.6576 C
VALVE, INJECTOR . . . . 2.1245 A
VALVE, INJECTOR CHECK . . . . 2.1200 A
VALVE, OIL COOLER BY-PASS . . . . 4.4140 A
VALVE, OIL FILTER BY-PASS . . . . 4.2400 A
VALVE, OIL FILTER BY-PASS . . . . 4.2485 A
VALVE, OIL FILTER BY-PASS . . . . 8.1983 A
VALVE, OIL FILTER BY-PASS . . . . 9.1796 A
VALVE, OIL FILTER PRESSURE REGULATOR . . . . 8.3884 B

PART NAME GROUP NO.

VALVE, OIL FILTER PRESSURE REGULATOR. . 8.3884 B
VALVE, OIL FILTER TUBE ADAPTOR BY-PASS . . . . 4.3055 A
VALVE, OIL PRESSURE REGULATOR AND RELIEF. . . . . 4.1700 C
VALVE, OIL PUMP RELIEF. . . . . 4.1250 A
VALVE, STARTING AID PUMP INLET. . . . .12.6340 C
VALVE, STARTING AID PUMP OUTLET . . . .12.6345 C

W

WASHER, BLOWER DRIVE GEAR HUB THRUST. 3.4320
WASHER, BLOWER DRIVE GEAR HUB THRUST. . 3.4302
WASHER, BLOWER DRIVE GEAR THRUST. . . . 3.4302
WASHER, CAMSHAFT END BEARING THRUST . . 1.7030
WASHER, CRANKSHAFT CAP RETAINER - FRONT 1.3057
WASHER, CRANKSHAFT MAIN BEARING THRUST. 1.3100
WASHER, FLEXIBLE SHAFT TIP RETAINING. .12.6510 B
WASHER, FUEL PIPE CONNECTION. 2.4050
WASHER, GOVERNOR SHUTDOWN SHAFT (PACKING) . . . . 2.7145 A
WASHER, GOVERNOR THROTTLE SHAFT . . . . 2.8580 A
WASHER, GOVERNOR THROTTLE SHAFT (PACKING) . . . . 2.7140 A
WASHER, PLANETARY GEAR RETAINING. . . . 9.1050 A
WASHER, PLANETARY GEAR THRUST . . . . . 9.1085 A
WASHER, REDUCTION GEAR DRIVE SHAFT THRUST. . . . . 9.1325 A
WASHER, REVERSE GEAR DRIVE SHAFT THRUST. . . . . 9.1101 A
WASHER, REVERSE SUN GEAR THRUST . . . . 9.1075 A
WASHER, SELECTOR VALVE LOCATING SCREW . . . . 9.1170 A
WASHER, THROTTLE CONTROL TUBE BRAKE . . . . 2.9105 A
WASHER, THROTTLE CONTROL TUBE BRAKE . . 2.9105 A
WATER HEATER. . . . . .12.6403 C
WEIGHT & CARRIER ASSY., OVERSPEED TRIP GOVERNOR . . . . 7.4623 C
WEIGHT AND CARRIER ASSY., OVERSPEED TRIP GOVERNOR . . . . 7.4623 C
WEIGHT ASSY., GOVERNOR. . . . . 8.3405 A
WEIGHT, FRONT BALANCE 1.7140
WEIGHT, GOVERNOR. . . . . 2.7390 A
WEIGHT, OVERSPEED TRIP GOVERNOR . . . . 7.4625 C
WEIGHT, REAR BALANCE. 1.7150
WHEEL, COMPRESSOR . . . . 3.5036 A
WIRE ASSY., GENERATOR TO REGULATOR. . . 7.1630 A
WIRE ASSY., GENERATOR TO VOLTAGE REGULATOR . . . . 7.1630 A
WIRE ASSY., GENERATOR VOLTAGE REGULATOR . . . . 7.1630 A
WIRE ASSY., INSTRUMENT PANEL. . . . . . 7.4105 A
WIRE, AIR INLET HOUSING SHUTDOWN CONTROL . . . . 3.3250 A
WIRE, AIR SHUT-OFF CONTROL. . . . . . . 7.4525 C
WIRE, AIR SHUTOFF CONTROL (RESET) . . . 7.4525 C
WIRE, GOVERNOR CONTROL. . . . . 2.9422 A
WIRE, STARTING AID CONTROL. . . . . . .12.6378 C

PART NAME GROUP NO. PART NAME GROUP NO.

WIRE, STARTING MOTOR SOLENOID SWITCH
    ENGINE BASE . . . . 7.7090 A
WORM, VERNIER THROTTLE CONTROL. . . . . 2.9139 A

Y

YOKE, CLUTCH RELEASE. . . . . 8.1275 A
YOKE, HYDRAULIC STARTER CLUTCH. . . . .12.6508 D

C

05150362 CC6 C06006. . 5.1040

MODEL DESCRIPTION CHART

7 0 8 2 - 7 2 0 1

SERIES 71 V ENGINES	NUMBER OF CYLINDERS	APPLICATION DESIGNATION (see below)	BASIC ENGINE ARRANGEMENT AND DRIVE SHAFT ROTATION (see below)	DESIGN VARIATION (see below)	SPECIFIC MODEL NUMBER

APPLICATION DESIGNATION

7082—7200	MARINE
7083—7200	FAN TO F/W—INDUSTRIAL
7084—7200	POWER-BASE
7085—7200	GENERATOR
7087—7200	FAN TO F/W—AUTOMOTIVE
7088—7200	CUSTOMER SPEC. ENGINE

BASIC ENGINE ARRANGEMENTS:

Rotation: L (left) and R (right) designates rotation viewed from the front of engine.

Type: A-B-C-D designates location of starter and oil cooler as viewed from the rear (flywheel) end.

Cylinder Bank: Left and right cylinder banks are determined from rear of engine.

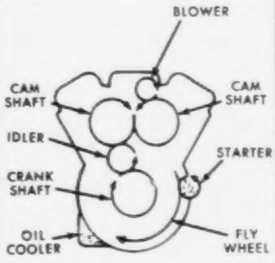
DESIGN VARIATIONS

7082—7000	V-71 "N" ENGINE
7082—7100	2 VALVE HEAD
7082—7200	4 VALVE HEAD
7082—7300	TURBOCHARGED

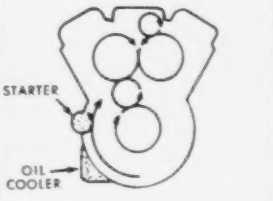
DRIVE SHAFT ROTATION

7242—0200	LEFT HAND
7242—9200	RIGHT HAND

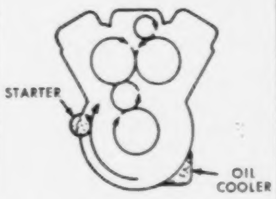
Drive shaft rotation: rotation on multiple units is determined from the rear of unit.


BLOWER
CAM SHAFT
CAM SHAFT
IDLER
STARTER
CRANK SHAFT
OIL COOLER
FLY WHEEL

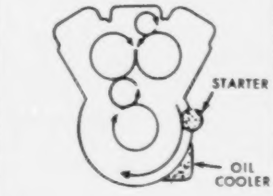
LA (XXXX-1XXX)


STARTER
OIL COOLER

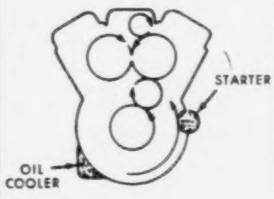
LB (XXXX-2XXX)


STARTER
OIL COOLER

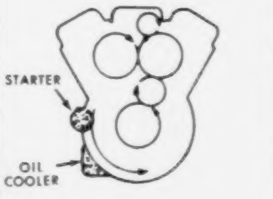
LC (XXXX-3XXX)


STARTER
OIL COOLER

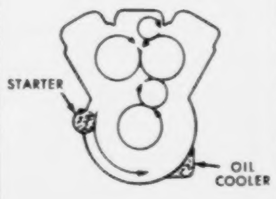
LD (XXXX-4XXX)


STARTER
OIL COOLER

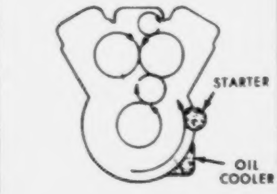
RA (XXXX-5XXX)


STARTER
OIL COOLER

RB (XXXX-6XXX)


STARTER
OIL COOLER

RC (XXXX-7XXX)


STARTER
OIL COOLER

RD (XXXX-8XXX)

ALL VIEWS FROM FLYWHEEL (REAR) END OF ENGINE
ENGINE ROTATION DETERMINED BY VIEWING ENGINE FROM BALANCE WEIGHT COVER (FRONT) END

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover

2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls

3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler

4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System

5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter

6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections

7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid

8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines

9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission—Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car

10.0000	SHEET METAL
10.1000A	Engine Hood

11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base

12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits

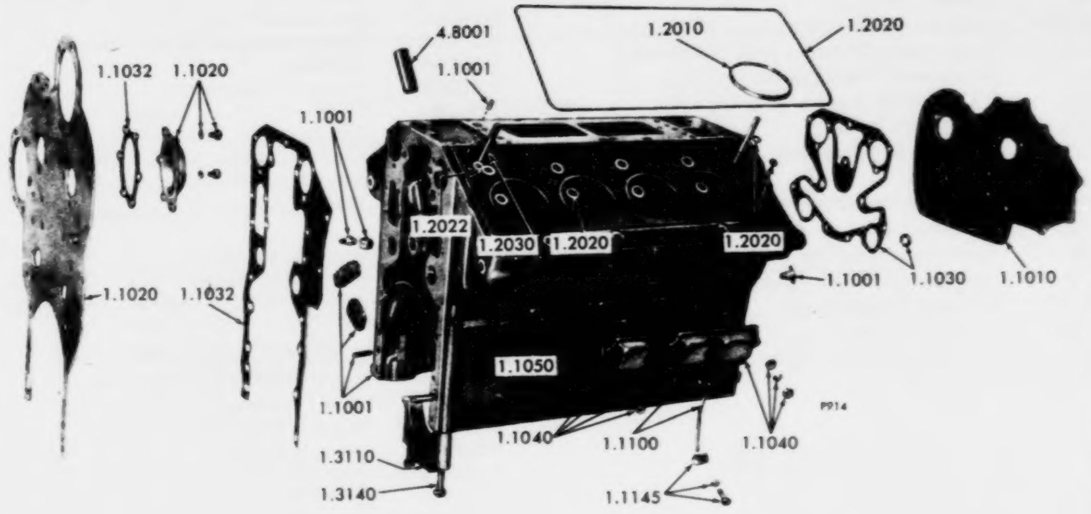
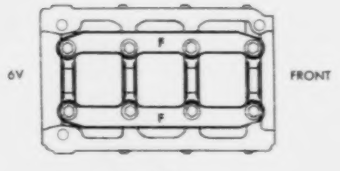
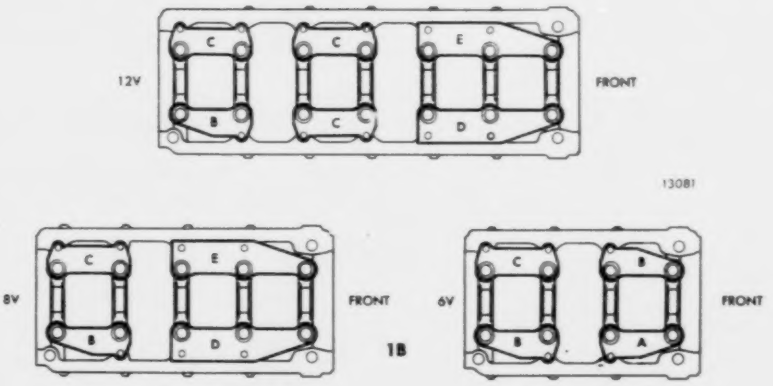

4.8001
1.1001
1.2010
1.2020
1.1032
1.1020
1.1001
1.2022
1.2030
1.2020
1.2020
1.1001
1.1030
1.1010
1.1020
1.1032
1.1050
1.1001
P914
1.1040
1.1100
1.1040
1.3110
1.3140
1.1145

FIG. 1A CYLINDER BLOCK



1C


12V
C
C
E
B
C
D
FRONT
13081
8V
C
E
B
D
FRONT
6V
C
B
B
A
FRONT

1B

FIGS. 1B, 1C BEARING CAP STABILIZER

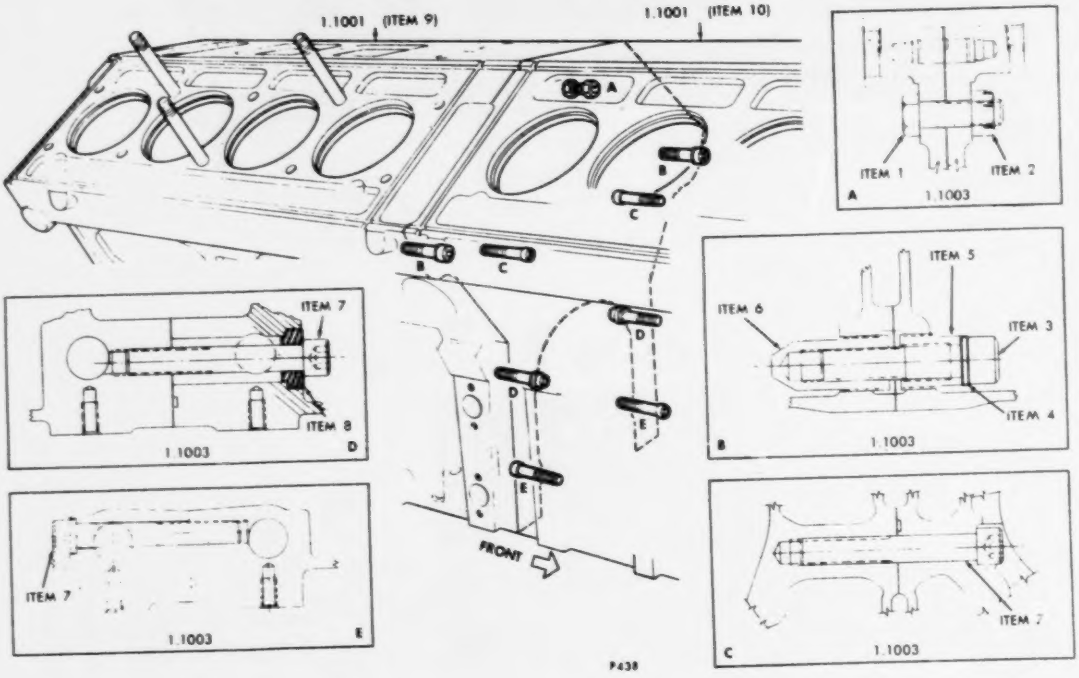

1.1001 (ITEM 9)
1.1001 (ITEM 10)
A
B
C
D
E
FRONT
ITEM 1
ITEM 2
ITEM 3
ITEM 4
ITEM 5
ITEM 6
ITEM 7
ITEM 8
1.1003
P438

FIG. 1D CYLINDER BLOCK FASTENERS(16V FRONT AND REAR)

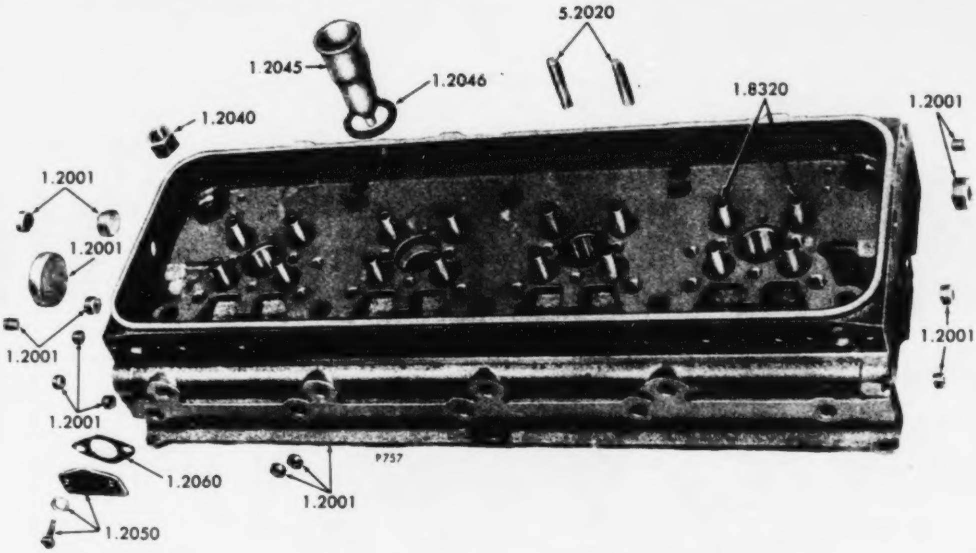

5.2020
1.2045
1.2046
1.2040
1.8320
1.2001
1.2001
1.2001
1.2001
1.2001
1.2001
1.2060
1.2050
1.2001
P757

FIG. 2A CYLINDER HEAD

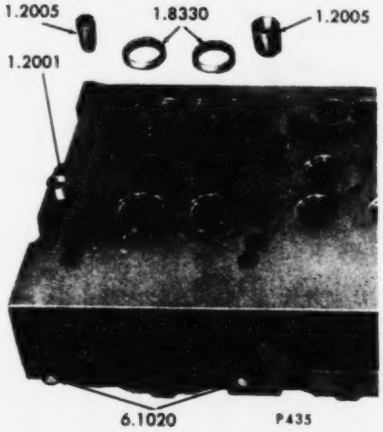

1.2005
1.8330
1.2005
1.2001
6.1020
P435

FIG. 2B

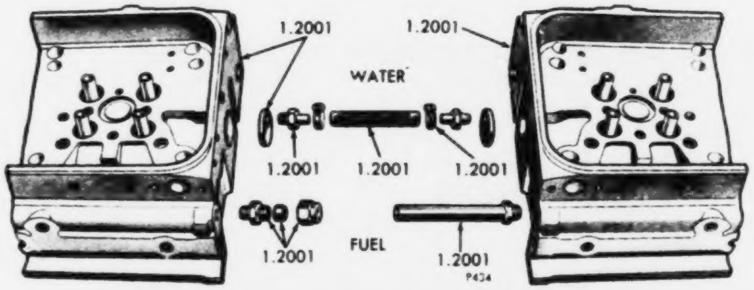

1.2001
1.2001
WATER
1.2001
1.2001
1.2001
1.2001
FUEL
1.2001
P434

FIG. 2C INTERCONNECTION OF CYLINDER HEADS ON 16V-71

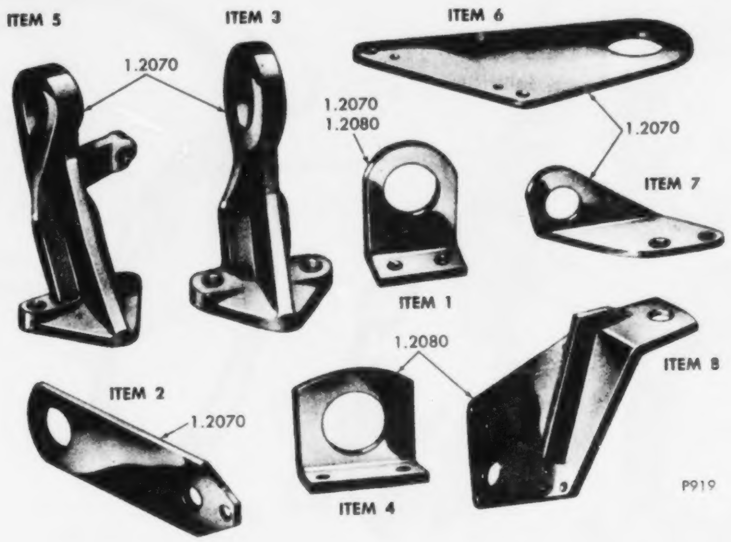

ITEM 5
ITEM 3
ITEM 6
1.2070
1.2070
1.2080
1.2070
ITEM 7
ITEM 1
1.2080
ITEM 8
ITEM 2
1.2070
ITEM 4
P919

FIG. 2E ENGINE LIFTER BRACKET

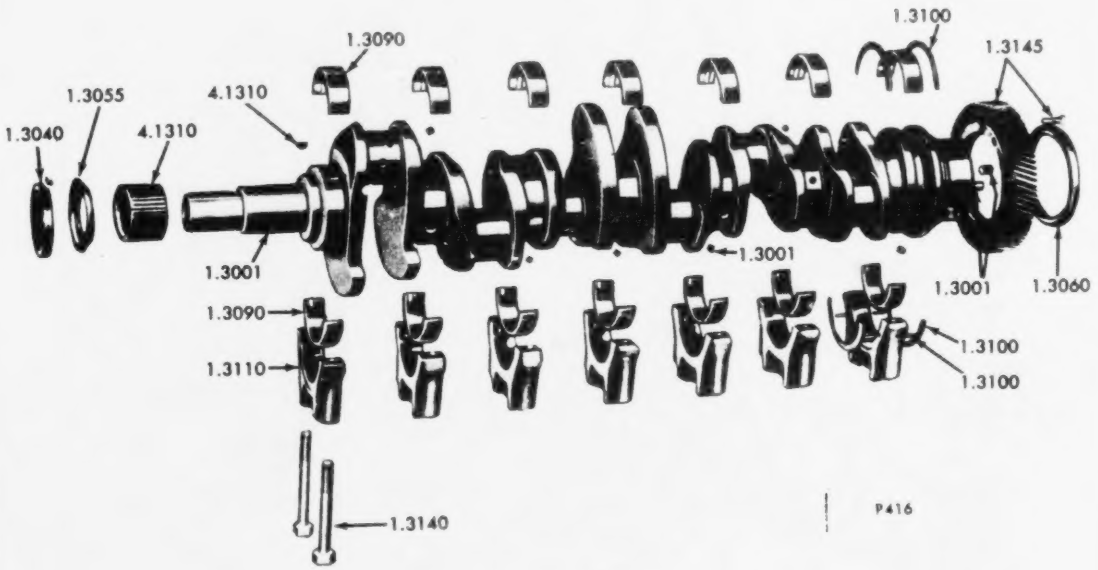
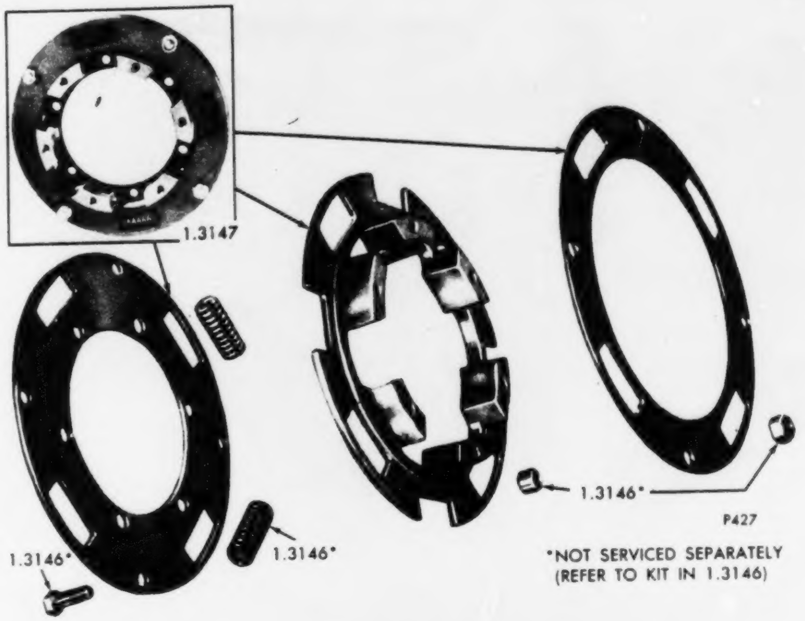

1.3100
1.3090
1.3145
1.3055
4.1310
1.3040
4.1310
1.3001
1.3001
1.3001
1.3060
1.3090
1.3100
1.3110
1.3100
1.3140
P416

FIG. 3A CRANKSHAFT


1.3147
1.3146*
1.3146*
1.3146*
P427

*NOT SERVICED SEPARATELY
(REFER TO KIT IN 1.3146)

FIG. 3B VIBRATION DAMPER, FRONT CRANKSHAFT GEAR (16V-71)

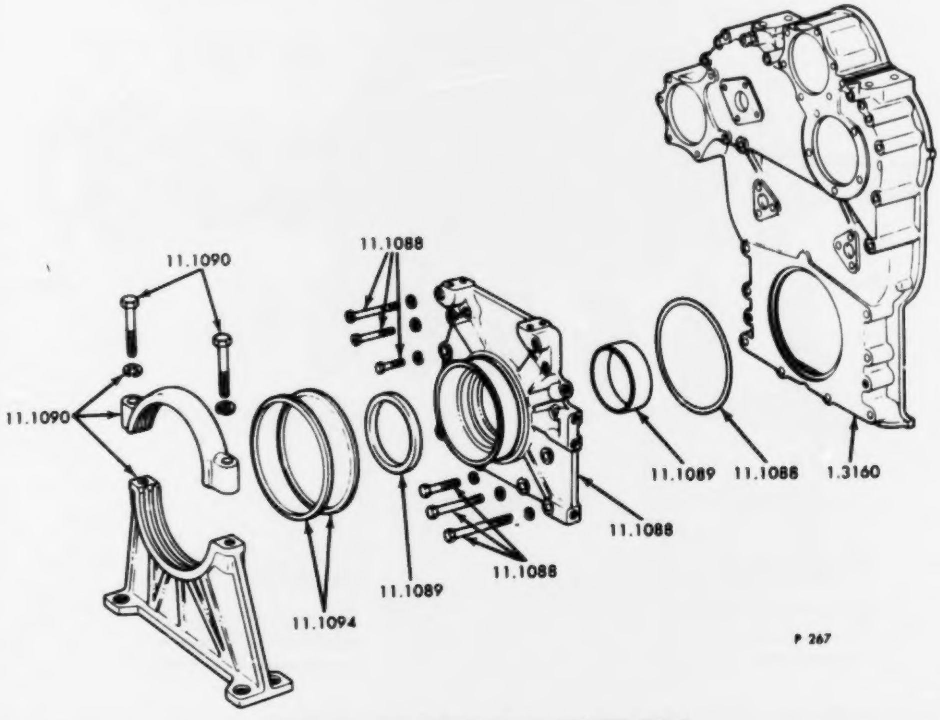
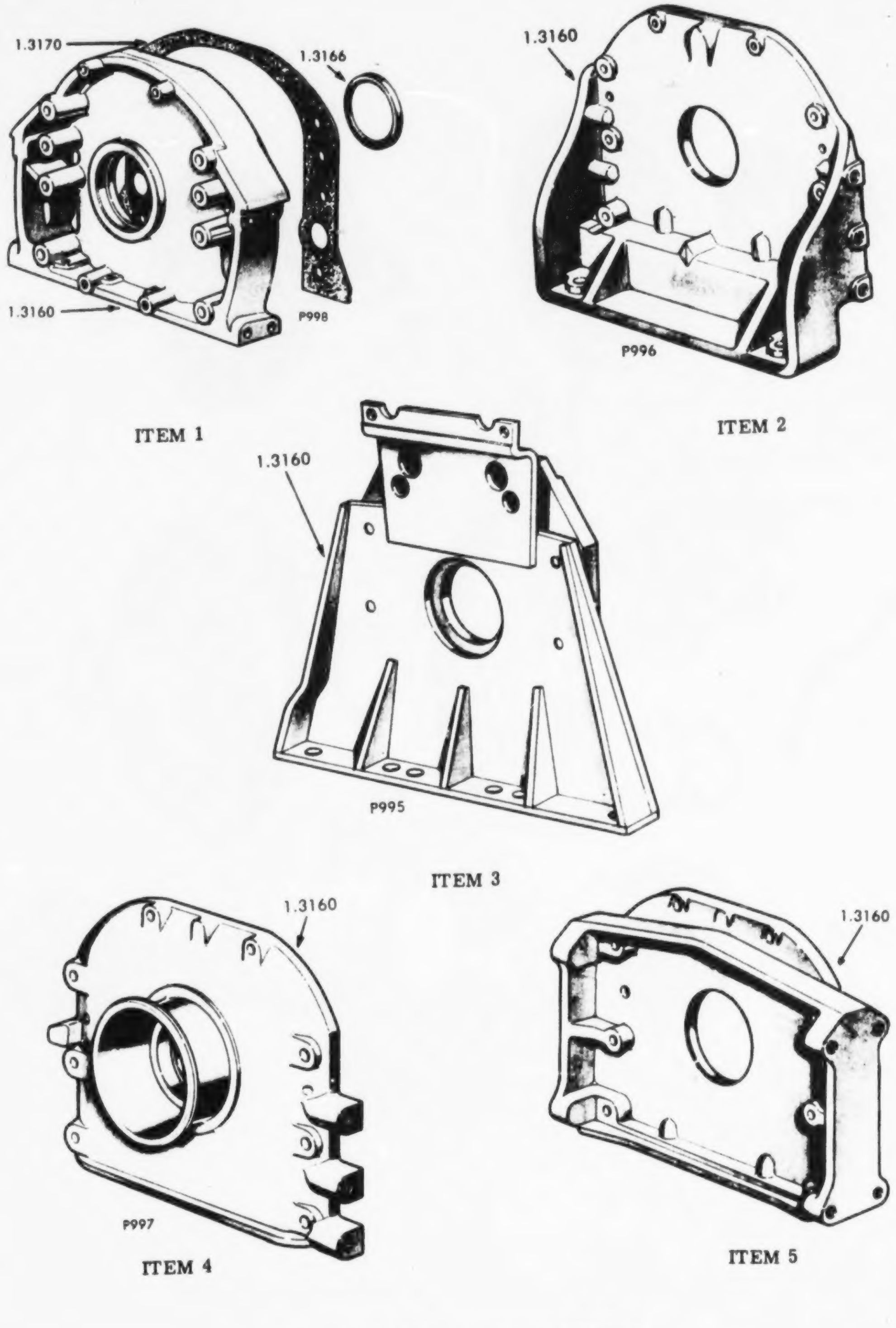

11.1088
11.1090
11.1090
11.1089
11.1088
1.3160
11.1088
11.1088
11.1089
11.1094
P 267

FIG. 4A ENGINE FRONT COVER (16V)


1.3170
1.3166
1.3160
P998
1.3160
P996
1.3160
P995
1.3160
P997
1.3160

ITEM 1

ITEM 2

ITEM 3

ITEM 4

ITEM 5

FIG. 4B ENGINE FRONT COVERS

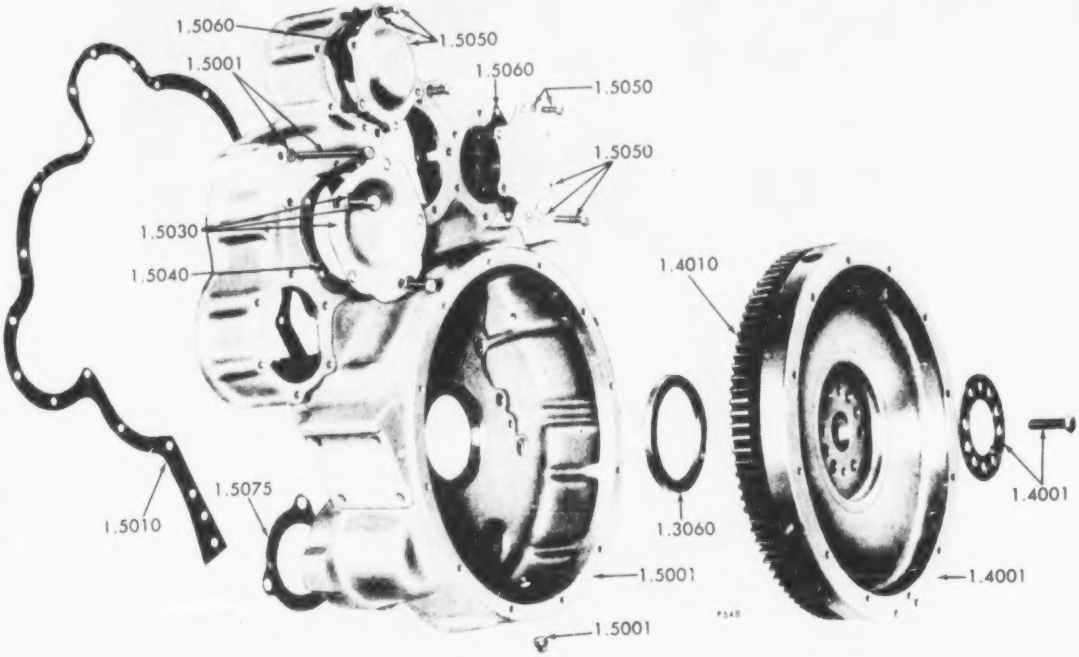

1.5060
1.5050
1.5001
1.5060
1.5050
1.5050
1.5030
1.5040
1.4010
1.4001
1.3060
1.5075
1.5010
1.5001
1.4001
1.5001

FIG. 6A FLYWHEEL AND FLYWHEEL HOUSING

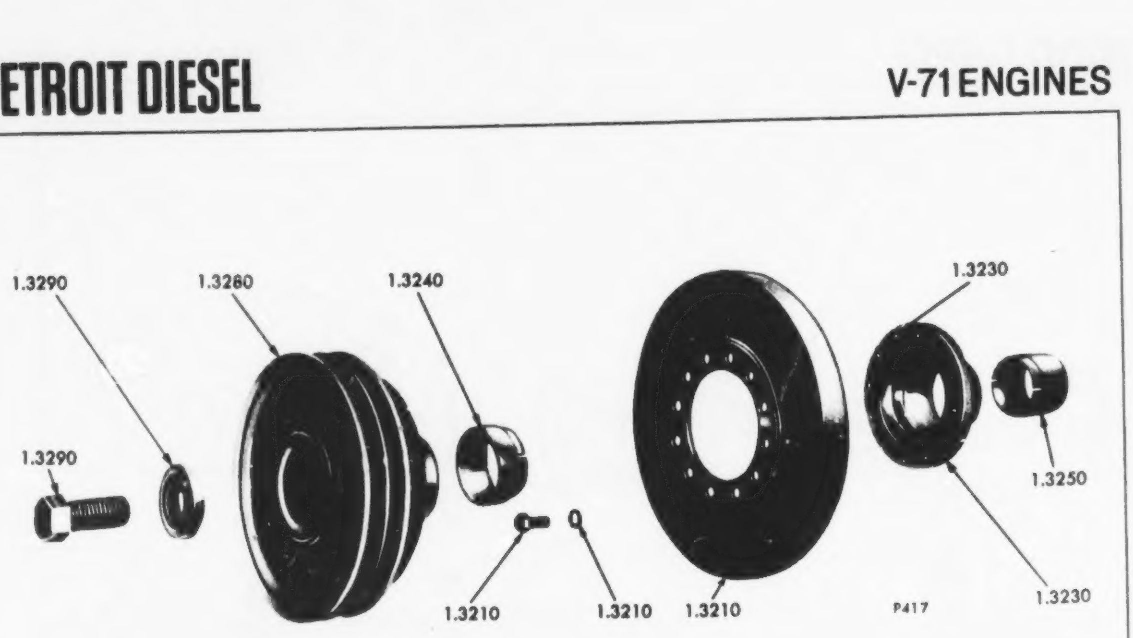

1.3290
1.3280
1.3240
1.3230
1.3290
1.3250
1.3210
1.3210
1.3210
P417
1.3230

FIG. 5A CRANKSHAFT PULLEY, VIBRATION DAMPER AND HUB

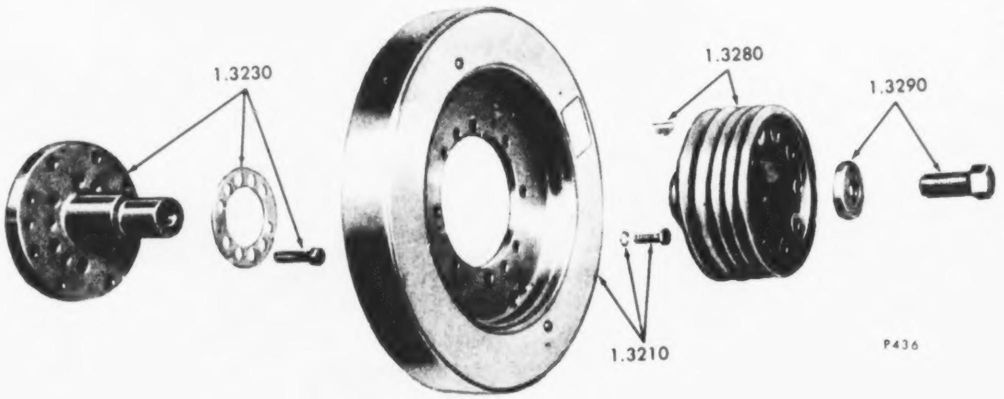

1.3230
1.3280
1.3290
1.3210
P436

FIG. 5B CRANKSHAFT PULLEY AND VIBRATION DAMPER

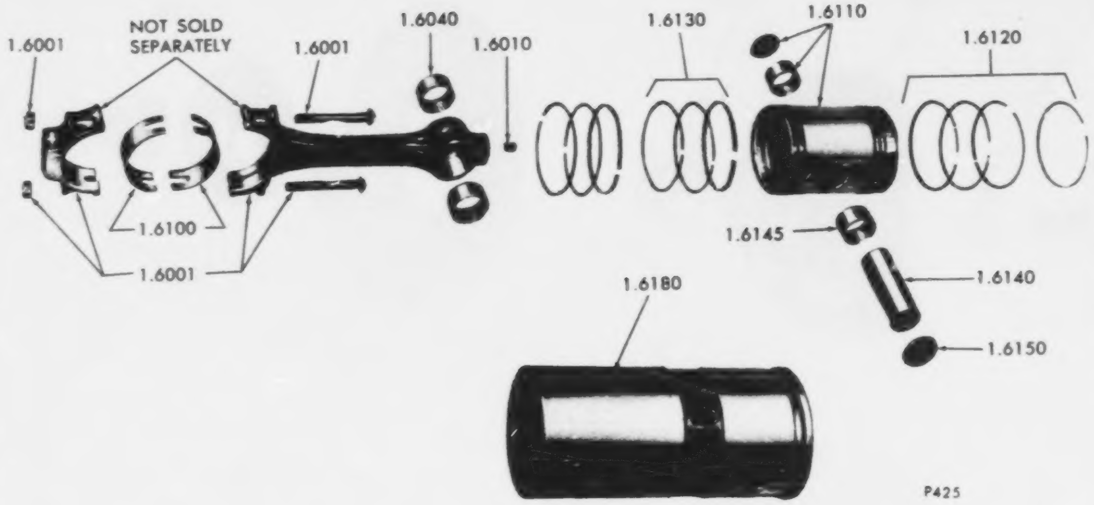

1.6001
NOT SOLD SEPARATELY
1.6001
1.6040
1.6010
1.6130
1.6110
1.6120
1.6100
1.6001
1.6145
1.6140
1.6180
1.6150
P425

FIG. 7A CONNECTING ROD AND PISTON

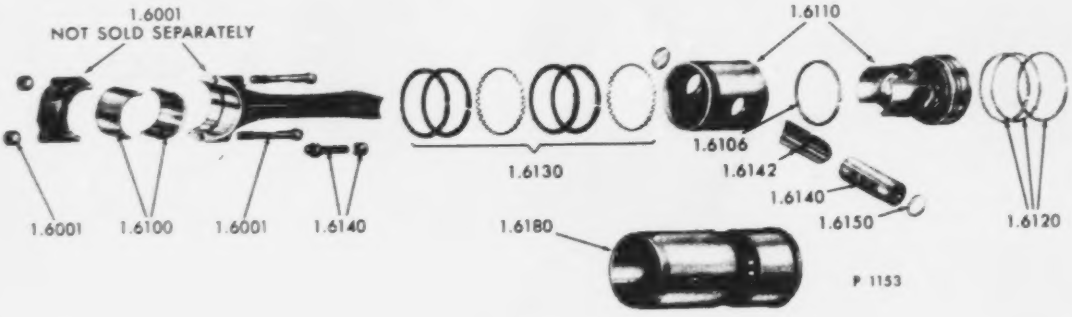

1.6001
NOT SOLD SEPARATELY
1.6110
1.6106
1.6130
1.6142
1.6140
1.6001
1.6100
1.6001
1.6140
1.6180
1.6150
1.6120
P 1153

FIG. 7B CONNECTING ROD AND PISTON
(CROSSHEAD)

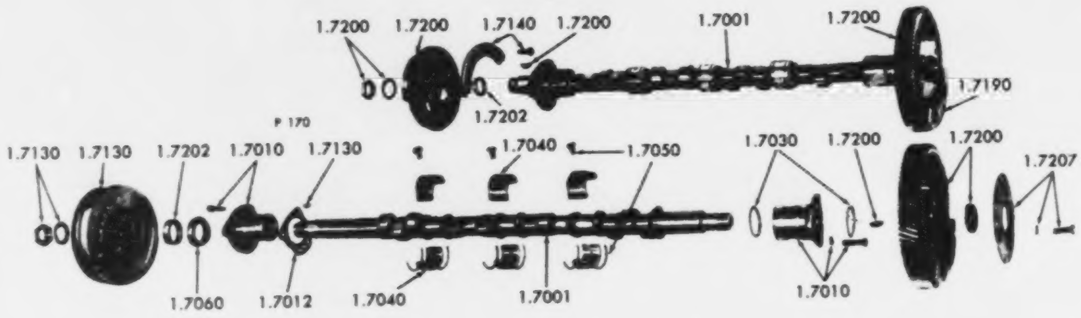

1.7200
1.7200
1.7140
1.7200
1.7001
1.7200
1.7190
1.7202
P 170
1.7130
1.7130
1.7202
1.7010
1.7130
1.7040
1.7050
1.7030
1.7200
1.7200
1.7207
1.7060
1.7012
1.7040
1.7001
1.7010

FIG. 7C CAMSHAFT AND GEAR

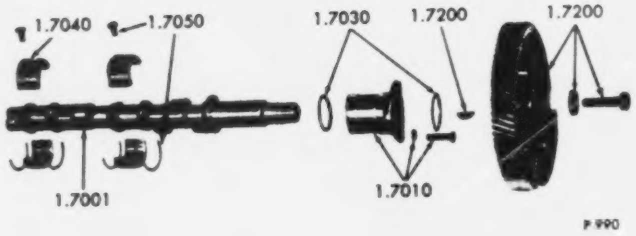

1.7040
1.7050
1.7030
1.7200
1.7200
1.7001
1.7010
P 990

FIG. 7D CAMSHAFT AND GEAR - 6V, 8V-71
(RIGHT BANK, LH ENGINE)

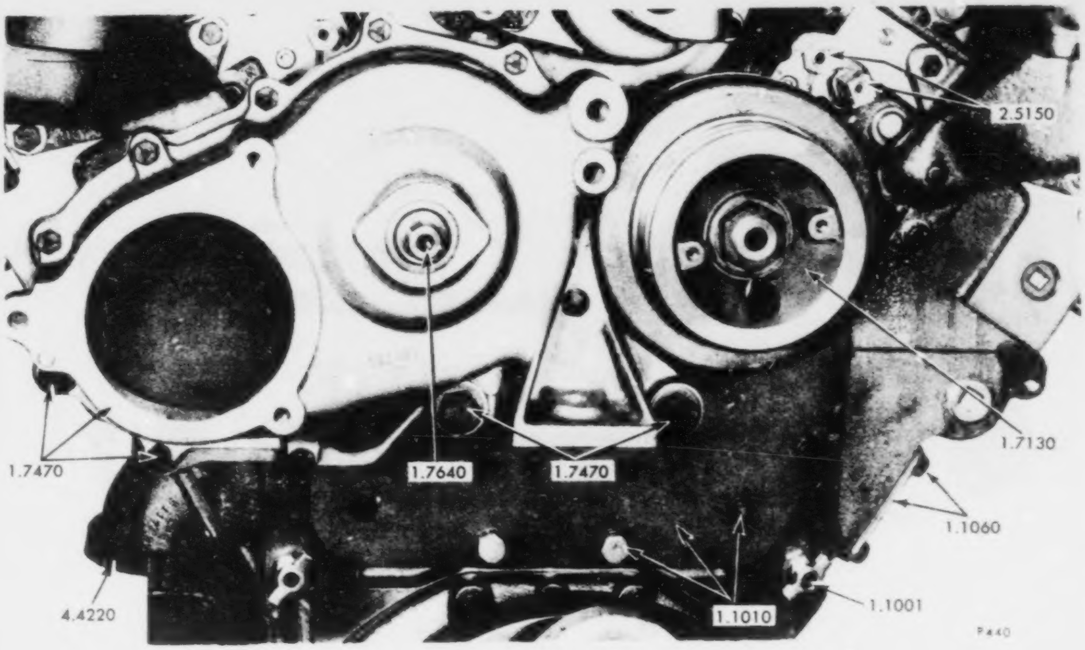

2.5150
1.7130
1.1060
1.1001
1.1010
1.7640
1.7470
1.7470
4.4220
P440

FIG. 9A CAMSHAFT PULLEY & WATER PUMP DRIVE

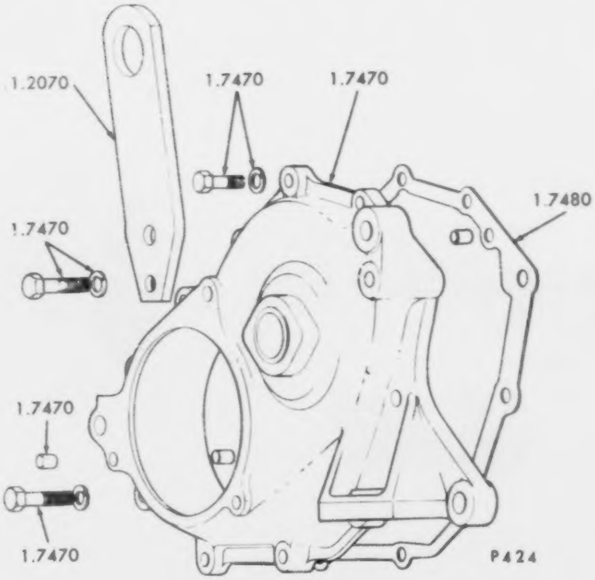

1.2070
1.7470
1.7470
1.7480
1.7470
1.7470
1.7470
P424

FIG. 9B

BALANCE WEIGHT COVER

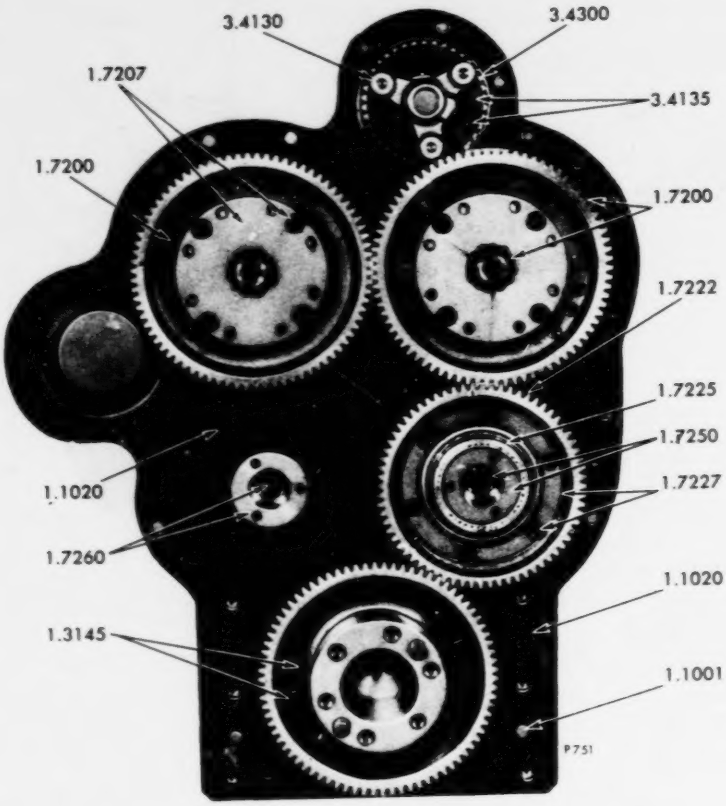

3.4130
3.4300
1.7207
3.4135
1.7200
1.7200
1.7222
1.7225
1.7250
1.1020
1.7227
1.7260
1.1020
1.3145
1.1001
P751

FIG. 8A GEAR TRAIN

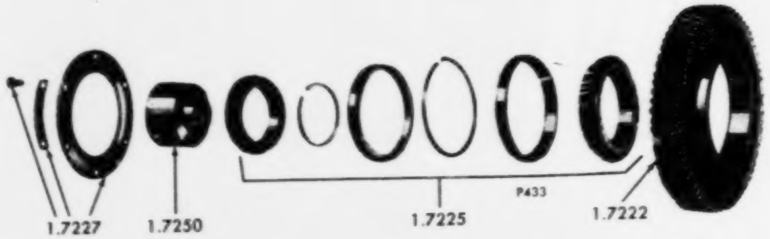

1.7227
1.7250
1.7225
P433
1.7222

FIG. 8B IDLER GEAR

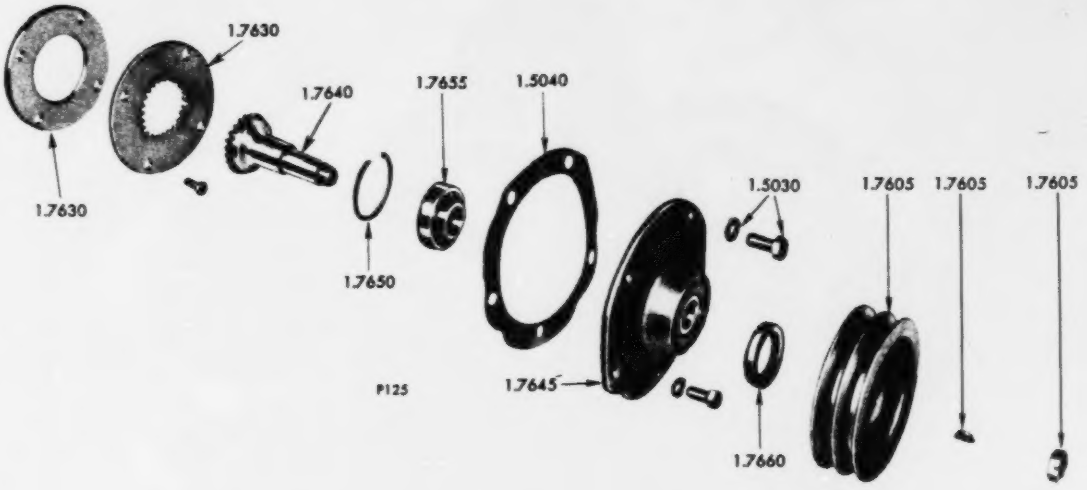

1.7630
1.7630
1.7640
1.7655
1.5040
1.7650
1.5030
1.7605
1.7605
1.7605
1.7645
1.7660
P125

FIG. 10A

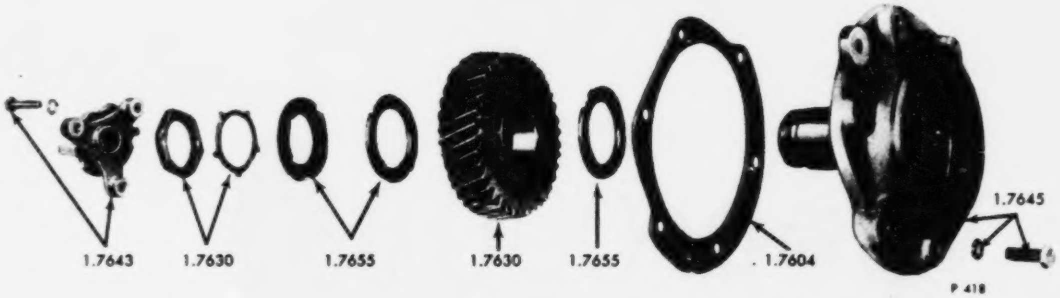

1.7643
1.7630
1.7655
1.7630
1.7655
1.7604
1.7645
P 418

FIG. 10B

ACCESSORY DRIVE

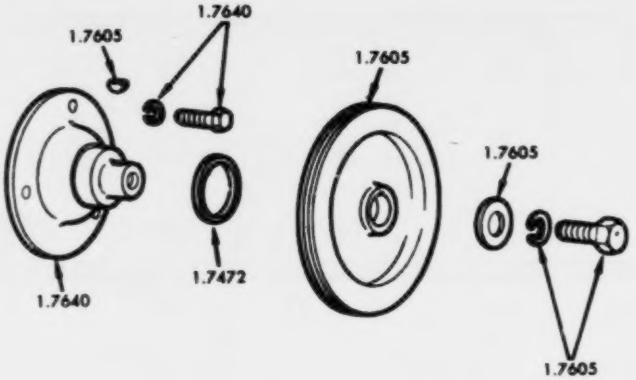

1.7605
1.7640
1.7605
1.7605
1.7640
1.7472
1.7605

FIG. 10C

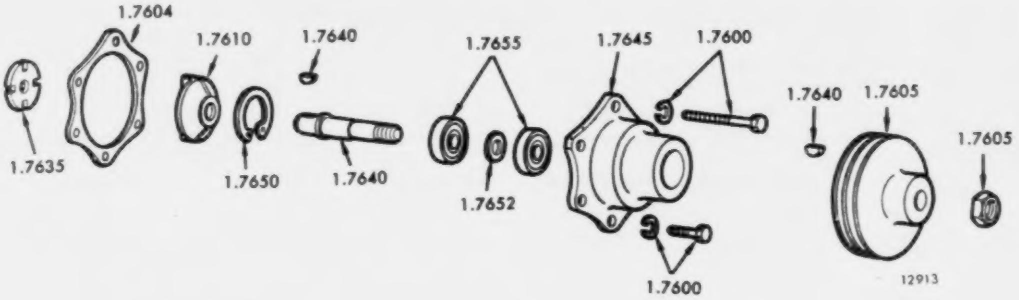

1.7604
1.7610
1.7640
1.7655
1.7645
1.7600
1.7640
1.7605
1.7605
1.7635
1.7650
1.7640
1.7652
1.7600
12913

FIG. 10D

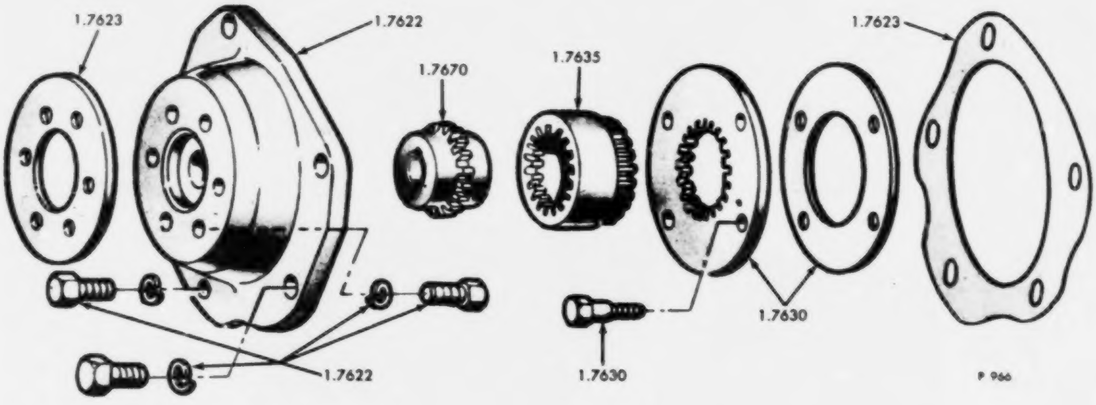
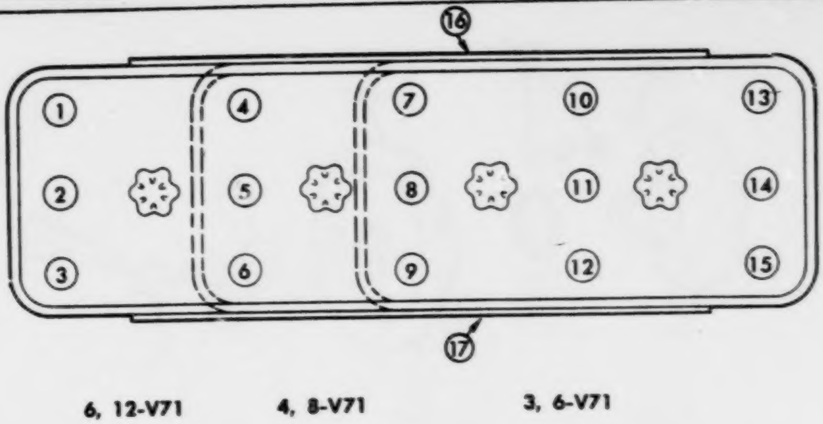

1.7623
1.7622
1.7670
1.7635
1.7623
1.7630
1.7622
1.7630
P 966

FIG. 10E

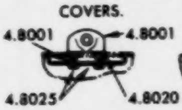
ACCESSORY DRIVE


16
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
17
6, 12-V71
4, 8-V71
3, 6-V71

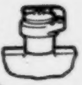
ROCKER COVER OIL FILLER AND BREATHER LOCATION

NOTE: OIL FILLER CAPS NOT BRAZED TO ROCKER COVER ARE SHOWN IN SECTION 4.5000A.

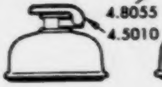
NOTE: BREATHER COMPONENTS ARE SHOWN IN SECTION 4.8000A, EXCEPT FOR TUBES BRAZED TO ROCKER COVERS.


4.8001
4.8001
4.8025
4.8020

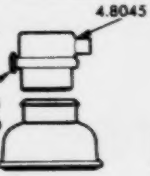
A
BREATHER



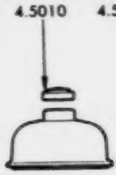
B
FILLER


4.8055
4.5010

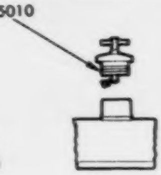
C
FILLER



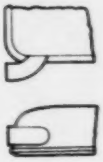
D
BREATHER



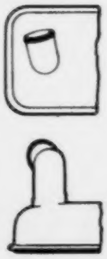
E
FILLER



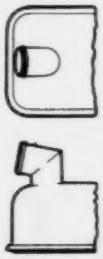
F
FILLER



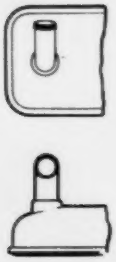
G
BREATHER



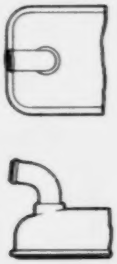
H
FILLER



I
FILLER



J
FILLER



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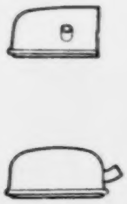

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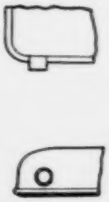

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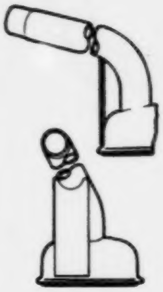

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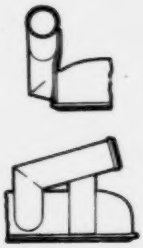

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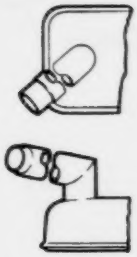

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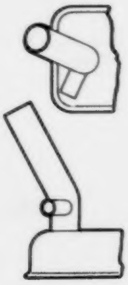

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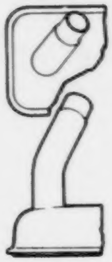

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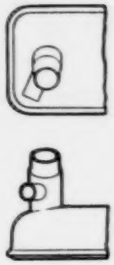

P 452

S
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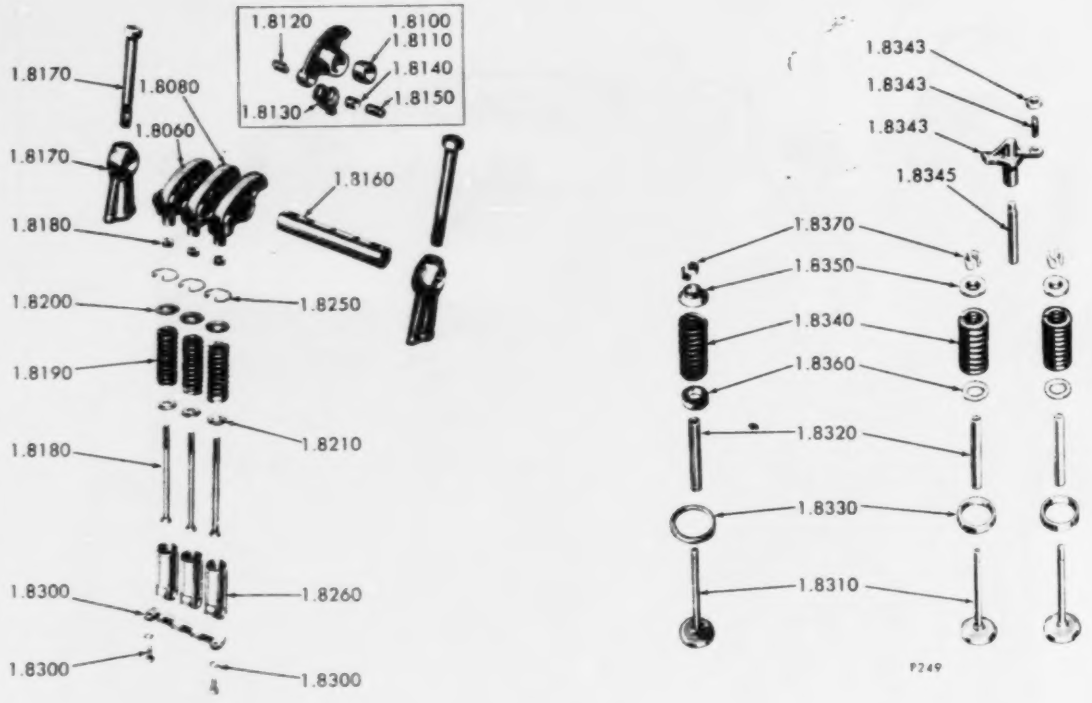
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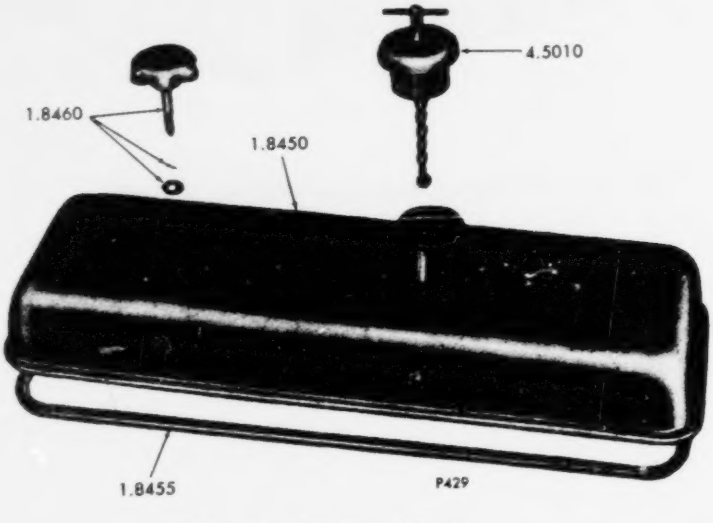
1.8180
1.8200
1.8250
1.8190
1.8180
1.8210
1.8300
1.8260
1.8300
1.8300
1.8343
1.8343
1.8343
1.8345
1.8370
1.8350
1.8340
1.8360
1.8320
1.8330
1.8310
P249

FIG. 11A

FIG. 11C
(2 valve)

FIG. 11B
(4 valve)

VALVE OPERATING MECHANISM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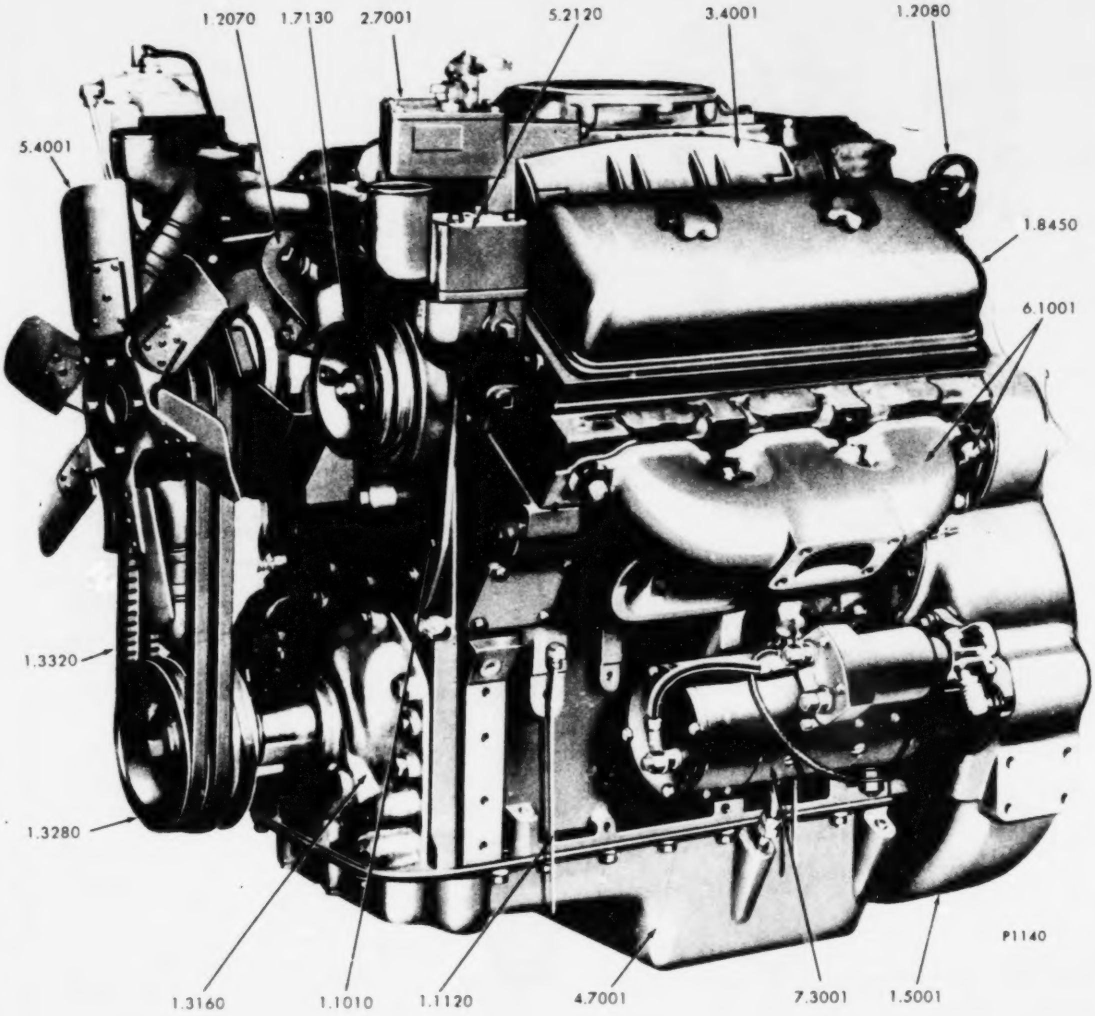
1.8460
1.8450
1.8455
P429

FIG. 12A ROCKER COVER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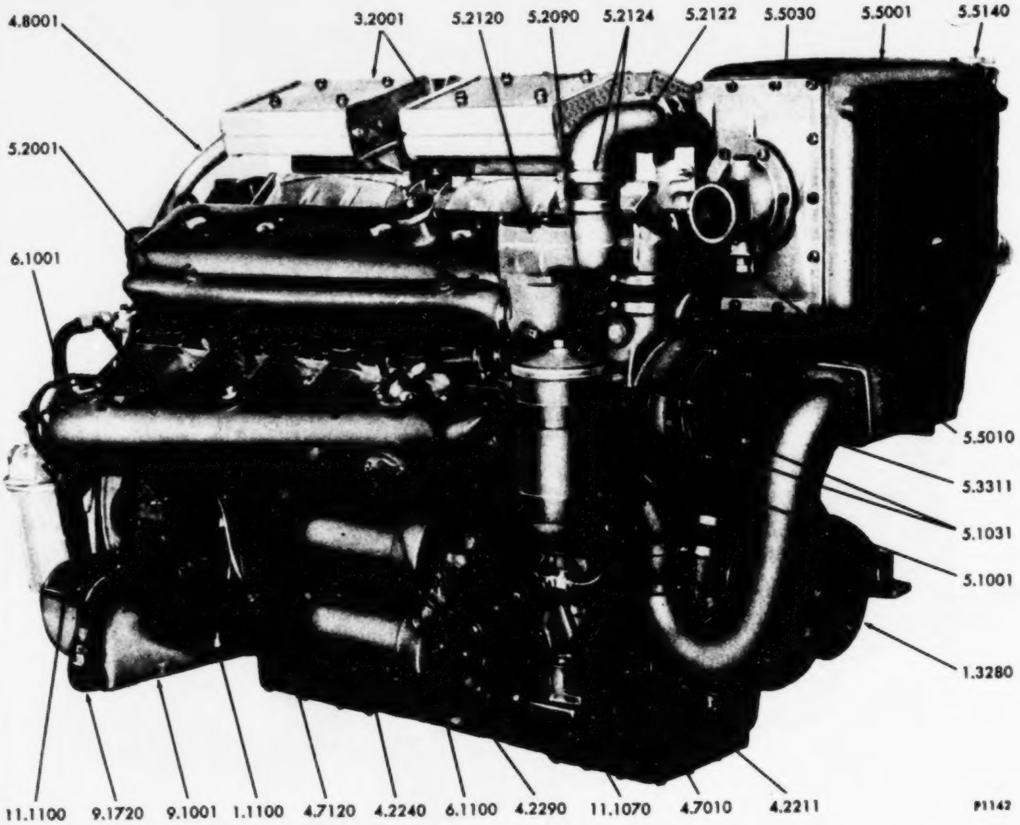
2.7001
5.2120
3.4001
1.2080
5.4001
1.8450
6.1001
1.3320
1.3280
P1140
1.3160
1.1010
1.1120
4.7001
7.3001
1.5001

TYPICAL FAN TO FLYWHEEL INDUSTRIAL ENGINE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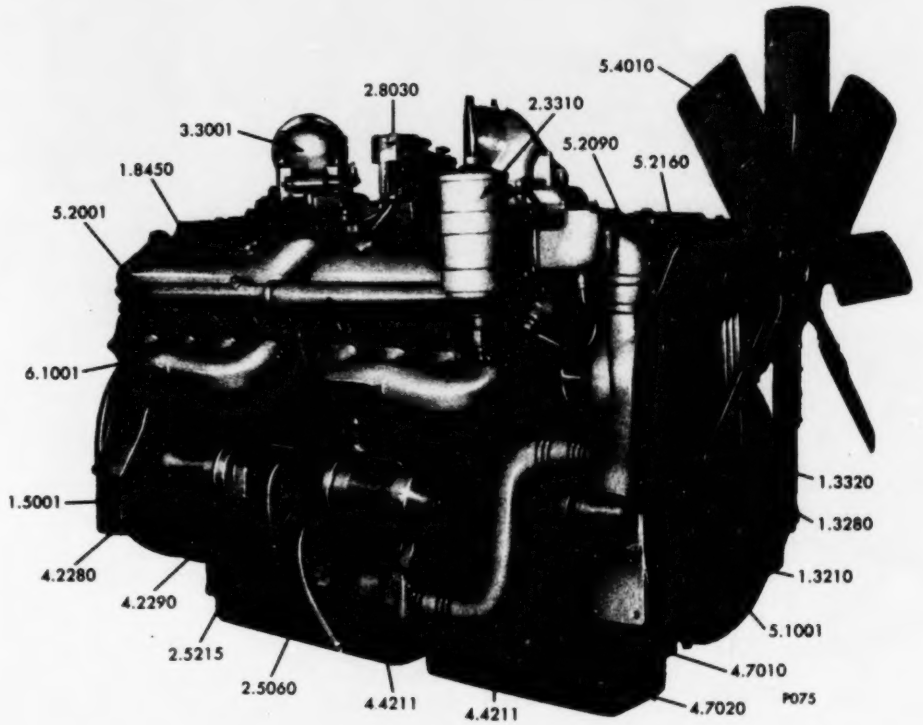
5.2090
5.2124
5.2122
5.5030
5.5001
5.5140
5.2001
6.1001
5.5010
5.3311
5.1031
5.1001
1.3280
11.1100
9.1720
9.1001
1.1100
4.7120
4.2240
6.1100
4.2290
11.1070
4.7010
4.2211
P1142

TYPICAL 12V-71 MARINE ENGINE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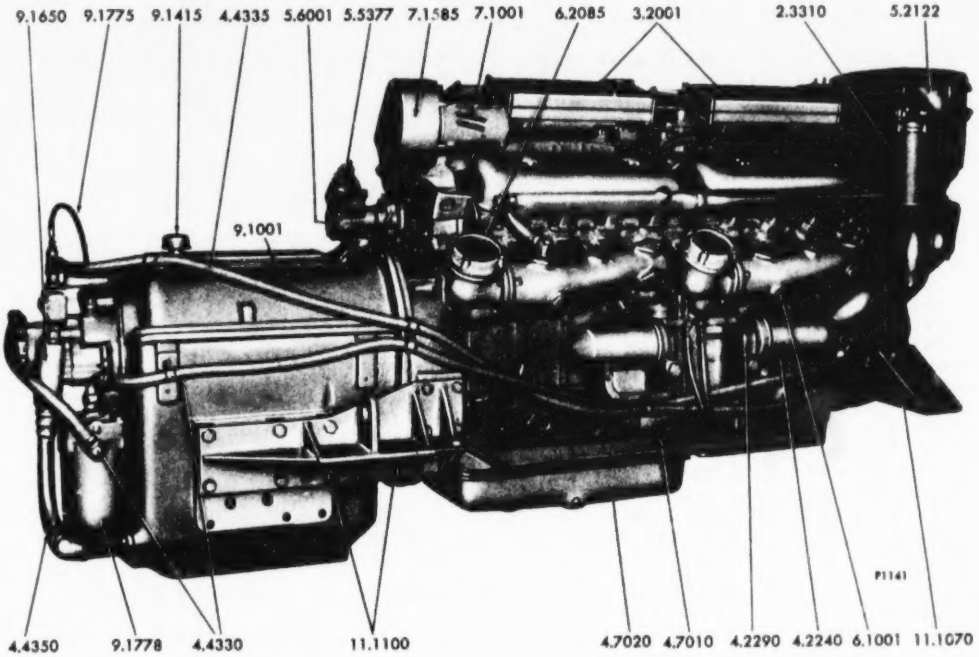
3.3001
5.2090
1.8450
5.2160
5.2001
6.1001
1.3320
1.5001
1.3280
4.2280
1.3210
4.2290
5.1001
2.5215
4.7010
2.5060
4.4211
4.4211
4.7020
P075

FIG. 13D 16V-71 FAN TO FLYWHEEL ENGINE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4.4335
5.6001
5.5377
7.1585
7.1001
6.2085
3.2001
2.3310
5.2122
9.1001
P1141
4.4350
9.1778
4.4330
11.1100
4.7020
4.7010
4.2290
4.2240
6.1001
11.1070

FIG. 13E 16V-71 MARINE UNIT

1.1000 CYLINDER BLOCK

1.1001 - BLOCK ASSY., CYLINDER

FOR TYPE 108 USE TYPE 92.
FOR COMPONENTS OF SERVICE CYLINDER BLOCK ASSEMBLIES REFER TO ASSEMBLY BREAKDOWN, PAGE A1.

FIG.	PART NUMBER		NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	167
1A	5199135		BLOCK ASSY. (W.B.P.) (6V)									1
1A	5199137		BLOCK ASSY. (W.B.P.) (8V)	1	1							
	5199143	*	BLOCK ASSY. (FRONT & REAR COMBINED) . (W.B.P.) (16V)								1	
1D	5199144		BLOCK ASSY. (FRONT BLOCK ONLY) . . . (W.B.P.) (16V)								1	
1D	5199145		BLOCK ASSY. (REAR BLOCK ONLY) . . . . (W.B.P.) (16V)								1	
1A	5145052		BLOCK ASSY. (2.26 DIA. HEATER HOLE) (TURBO) (W.B.P.) (12V)			1	1					
1A	5199418		BLOCK ASSY. (2.26 DIA. HEATER HOLE) (TURBO) (W.B.P.) (8V)					1		1		
1A	5199250		BLOCK ASSY. (1.12 DIA. HEATER . . . HOLE) (TURBO) (W.B.P.) (8V)						1			
	5123239	@	PIN, SPRING			1	1					
1A	141346		PIN, 3/16 X1/2 DOWEL, BRASS . . . . (12.9290)			4	4					4
1A	141214		PIN, 5/16 X7/16 DOWEL			4	4					
	5150042		PLUG (VERTICAL OIL PASSAGE) (1.2001)			1	1					
	5123862		PLUG (TOP FACE OF BLOCK)			2	2					2
	5121182		PLUG, 1/4 HEX. SOC. PIPE (12.9550) .			2	2					5
	5125237		PLUG, 1/4 PIPE (2.4015)		2			2	2	2		2
	5145014		PLUG, 1 1/8 PIPE SHORT. SOC. (12.9550)			1	1					1
	5115214		PLUG, 1/2 HEX. SOC. PIPE (12.9550) .			8	7					3
	5139988		PLUG, 1" CUP									1
	5111798		PLUG, 1" SQUARE SOCKET HEADPIPE (12.9550)									3
	5142549		PLUG, 3/4 PIPE (12.9550)			6	6					6
	5428477		PLUG, 15/16 DIA. CUP (2.7340) . . .			1	1					1
1A	5151576		DOWEL (FLYWHEEL HOUSING & FRONT . . .			4	4					4
	5103045		PIN, 5/16 x 7/16 DOWEL									3
	103196		STUD, 3/8 -16-24X1 9/16 (12.9117) .			4	4					2
	103197		STUD, 3/8 -16-24X13/16 (12.9117) . .			2	2					
	103647		DRAINCOCK, 1/4 (12.9510)				2					2
1A	118536	#	DRAINCOCK, 3/8 (12.9510)	3		1	1					1
1A	142767	#	BUSHING, 3/4 -3/8 RED. PIPE . . . . (12.9570)	2								

* NOT SERVICED. USE FRONT AND REAR ASSEMBLIES. REFER TO 1.1003 FOR ATTACHING PARTS.
@ OBSOLETE.
# FOR DRY BLOCKS ONLY.

1.1002 - GASKET KIT, ENGINE OVERHAUL

KITS 5196273, 5196274, 5196963 AND 5198150 INCLUDE THE GASKETS NECESSARY TO OVERHAUL AN INDUSTRIAL

1.1002 - GASKET KIT, ENGINE OVERHAUL (CONT'D)

ENGINE. FOR MARINE ENGINES 5196376 AND 5196132 ARE REQUIRED IN ADDITION TO THE ABOVE. KIT 5196375 WHEN USED WITH 5196378 FOR MARINE OR 5196379 FOR INDUSTRIAL ENGINES, PROVIDES GASKETS NECESSARY FOR A COMPLETE ENGINE OVERHAUL. GASKET KITS DO NOT INCLUDE THE ADDITIONAL GASKETS REQUIRED FOR TURBOCHARGED ENGINES.

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	187
	5196373	GASKET KIT (STD. & W.B.P.) (8V) . . .	AR	AR			AR	AR	AR		AR
	5196375	GASKET KIT (STD. & W.B.P.) (12V) . .			AR	AR					
	5198150	GASKET KIT (W.B.P.) (16V)								AR	
	5197858	GASKET KIT (TURBO) (12V)						AR			

1.1003 - ATTACHING PARTS, CYLINDER BLOCK FRONT TO REAR 16V.

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	187
1D	5127196	PLUG, 1 EXT., 7/8 -14 INT. (ITEM 6)								2	
	5186579	SEAL RING - INTER BLOCK (WATER) . . . (1.2020)								2	
	5109346	SEAL - INTER BLOCK								1	
	5126030	ADAPTOR								2	
	141242	PIN, 3/8 X7/8 DOWEL (12.9290) . . .								2	
1D	5127197	PLUG, 1 EXT., 3/4 -10 INT. (ITEM 5) (1.5001)								2	
1D	5135244	BOLT, 5/8 -11X4 1/4 (ITEM 7) . . . . (1.1001)								6	
1D	271587	BOLT, 5/8 -18X2 (ITEM 1) (12.9001) .								1	
1D	5135243	BOLT, 3/4 -10X3 1/2 (ITEM 3) . . . . (1.1001)								2	
	5127952	WASHER, 1.12 X.755 (1.1001)								2	
1D	126023	NUT, 5/8 -HEX. (ITEM 2) (12.9120) . .								1	

1.1004 - BLOCK KIT, CONVERSION

KITS INCLUDE HAND HOLE COVERS AND GASKETS, AIR BOX DRAIN TUBES PLUS END PLATE GASKET AND ATTACHING PARTS ONLY TO CONVERT TO WATER BELOW PORT.

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	187
	5199245	CONVERSION KIT (8V-71)	1	1			1		1		
	5199246	CONVERSION KIT (12V-71)			1	1					
	5199247	CONVERSION KIT (16V-71)								1	
	5199279	CONVERSION KIT (8V-71) (TURBO) . . .						1			

1.1000 CYLINDER BLOCK

1.1010 - PLATE, CYLINDER BLOCK END FRONT

INCLUDES PLUG NUTS.

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	167
1A	5132422	PLATE ASSY.	1	1	1	1	1	1			1
1A	5117498	PLATE ASSY. (1.1020)								1	
	179839	BOLT, 3/8 -16X1 (12.9001)	13	10	10	10	10	10	10	19	13
	122408	BOLT, 1/2 -13X1 (12.9001)	2	2	2	2	2	2	2		2
	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR	AR	AR	AR	AR	AR	AR	5
	103323	LOCKWASHER, 1/2 (12.9200)	2	2	2	2	2	2	2		2
	5121459	NUT, 3/8 -24 PLUG (1.1020)	11	11	11	11	11	11			

1.1020 - PLATE, CYLINDER BLOCK END-REAR

INCLUDES PLUG NUTS.

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	167
	5102562	PLATE ASSY.									1
1A	5117498	* PLATE ASSY.	1	1	1	1	1	1	1	1	
	5148981	# PLATE ASSY. (LESS ACCESSORY HOLE)		1					1	1	
1A	5173865	@ PLATE ASSY.	1	1	1	1	1	1		1	
	5121459	NUT, 3/8-24 PLUG	11	11	11	11	11	11			10
	5117058	COVER	1	1	1	1	1	1	1	1	1
	179839	BOLT, 3/8 -16X1 (12.9001)	9	9	9	9	9	9	8	9	
	106284	BOLT, 3/8 -24X5/8 (12.9001)	2	2	2	2	2	2	2	2	2
	5152148	WASHER, 3/8 COPPER (2.4050)	2	2	2	2	2	2	2	2	2
	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR	AR	AR	AR	AR	AR	AR	8

* WITH NON-REINFORCED FLYWHEEL HOUSING FOR 16V.
@ WITH REINFORCED FLYWHEEL HOUSING FOR 16V.
# NOT SERVICED, USE 1-5117498, 1-5117058, 1-5117059, 2-106284, 1-5152148.

1.1030 - GASKET, CYLINDER BLOCK END PLATE (FRONT)

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	167
	5144901	GASKET									1
1A	5132445	GASKET	1	1	1	1	1	1	1		
1A	5121835	GASKET (17/32 I.D.X1.12 O.D.)	1	1	1	1	1	1	1		1
1A	5117031	GASKET								1	

1.1032 - GASKET, CYLINDER BLOCK END PLATE (REAR)

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	167
1A	5102551	GASKET (1.1030)	1	1	1	1	1	1	1	1	1
1A	5117059	GASKET (END PLATE COVER)	1	1	1	1	1	1	1	1	1

1.1040 - COVER, CYLINDER BLOCK HAND HOLE

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	167
	5144551	* COVER (3/4 TAPPED HOLE) (WATER BELCH PORT BLOCK)	AR	AR	AR	AR	AR	AR	AR	AR	
	5125005	@ COVER (PLAIN) (DRY BLOCK)	4					4			
	5102572										

1.1040 – COVER, CYLINDER BLOCK HAND HOLE (CONT'D)

FIG.	PART NUMBER	NAME AND DESCRIPTION	98	103	106	114	115	121	122	127	187
1A	5132458	COVER, SMALL (W.B.P.) (ALUM.)	4	4	8	8	4	4	4	8	2
1A	5144186	COVER, LARGE (W.B.P.) (ALUM.)	2	2	2	2	2	2	2	4	1
	5139783	& COVER & ELBOW ASSY. (DRY BLOCK)	1								
	5122317	# CLAMP	3					4			
	5140708	# CLAMP	1								
	5109470	@ # LOCKPLATE	3					4			
	5139786	# LOCKPLATE	1								
	5152121	STUD, 5/16 -24X1 1/2 (2.2005)	14	14	22	22	14	14	14	28	10
	5145009	PLUG, 1/8 PIPE (W.B.P.) (12.9550)	4	4		4	4	4	4	8	1
	5145011	PLUG, 3/8 SQ. HD. PIPE (W.B.P.)			4						
	106327	* BOLT, 5/16 -18X1 3/8 (12.9001)	6					8			
	180083	BOLT, 5/16 -18X1 1/2 (12.9001)	1								
	186271	BOLT, 5/16 -18X3 3/4 (12.9001)	1								
	103340	WASHER, 5/16 FLAT (12.9190)	14	14	22	22	14	14	14	28	10
	103320	LOCKWASHER, 5/16 (12.9200)	14	14	22	22	14	14	14	28	10
	114493	NUT, 5/16 -24 HEX. (12.9120)	14	14	22	22	14	14	14	28	10

* USED WITH AIR COMPRESSOR.

@ DEDUCT (1) WHEN 5124754 COVER IS USED.

& NO LONGER AVAILABLE FOR SERVICE.

DRY BLOCKS ONLY.

1.1050 – GASKET, CYLINDER BLOCK HAND HOLE COVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	98	103	106	114	115	121	122	127	187
1A	5132924	GASKET, SMALL (W.B.P.)	4	4	8	8	4	4	4	8	2
	5108401	GASKET (TURBO)						4			
1A	5132572	GASKET, LARGE (W.B.P.)	2	2	2	2	2	2	2	4	2
	5108401	# GASKET	1								
	5117016	# GASKET	3								

DRY BLOCKS ONLY.

1.1053 – JUNCTION BLOCK, AIR CYLINDER CONTROL

FIG.	PART NUMBER	NAME AND DESCRIPTION	98	103	106	114	115	121	122	127	187
	5140060	VALVE (CONTROL)	1								
	5140059	BLOCK ASSY., JUNCTION	1								

1.1060 – COVER, CYLINDER BLOCK WATER HOLE

FIG.	PART NUMBER	NAME AND DESCRIPTION	98	103	106	114	115	121	122	127	187
	5127788	# COVER (3/4 TAPPED HOLE)	1								
	5117733	COVER (PLAIN)	1	1	1	1	1	1			1
	5100903	@ COVER, AIR BOX HEATER (7.8160)				1					
	179838	BOLT, 3/8 -16X7/8 (12.9001)	4	4	4	4	4	4			4
	103341	WASHER, 3/8C FLAT (12.9190)	4	4	4	4	4	4			4
	103320	@ LOCKWASHER, 5/16 (12.9200)				2					

FIG.	PART NUMBER	NAME AND DESCRIPTION	96	103	106	114	115	121	122	127	167
	1.1060 -	COVER, CYLINDER BLOCK WATER HOLE (CONT'D)									
		# USED WITH AIR COMPRESSOR. @ FOR MODEL 7123-7356 ONLY.									
	1.1070 -	GASKET, CYLINDER BLOCK WATER HOLE COVER									
	5117734	GASKET (REAR ON 16V)	1	1	1	1	1	1			1
	5145581	@ GASKET (7.8020) @ FOR MODEL 7123-7356 ONLY.				1					

1.1000 CYLINDER BLOCK

1.1001 - BLOCK, CYLINDER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5199135	BLOCK ASSY. (6V-71 W.B.P.)	1													
1A	5199137	BLOCK ASSY. (8V-71 W.B.P.)		1												
	5199139	BLOCK ASSY. (12V-71 W.B.P.)			1											
	5199143	a BLOCK ASSY. (16V-71 W.B.P., FRONT AND REAR COMBINED)				1										
	5199144	BLOCK ASSY. (16V-71 W.B.P., FRONT ONLY)					1									
	5199145	BLOCK ASSY. (16V-71 W.B.P., REAR ONLY)						1								
1A	5199418	BLOCK ASSY. (8V-71 TURBO., W.B.P., 2.26 DIA. HEATER HOLE)							1							
	5145052	BLOCK ASSY. (12V-71 TURBO., W.B.P., 2.26 DIA. HEATER HOLE)								1						
	5199250	BLOCK ASSY. (8V-71 TURBO., W.B.P., 1.12 DIA. HEATER HOLE) THE FOLLOWING ITEMS ARE ASSEMBLED TO THE CYLINDER BLOCK									1					
1A	5117502	CAP, MAIN BEARING (UNFINISHED) (1.3110)	4	5	7	10	5	5	5	7	5					
1A	5196317	CAP, MAIN BEARING (FINISHED) (1.3110)	4	5	7	10	5	5	5	7	5					
1A	5116353	BOLT, MAIN BEARING CAP (1.3140)	8	10	10	12	6	6	6	14	6					
1A	5125198	BOLT, MAIN BEARING CAP (1.3140)			4	8	4	4	4		4					
	5196965	SPACER, MAIN BEARING CAP (SHIPPING ONLY)			4	8	4	4	4		4					
	5102373	WASHER, MAIN BEARING CAP BOLT (1.3140)	8	10	14	20	10	10	10	14	10					
	5121182	PLUG, 1/4 PIPE (12.9550)		2	2	18			2		2					
	5145014	PLUG, 3/8 SOC. HD. PIPE (12.9550)	1	1	1	1			2		2					
	5115214	PLUG, 1/2 PIPE (12.9550)	4	3	8	6	3	3	4		4					
	5142549	PLUG, 3/4 PIPE (12.9550)	6			2			1		1					
	5111798	PLUG, 1 SQ. SOC. HD. PIPE (12.9550)	11	10	12	6	3	3	10	12	10					
	5127196	PLUG, 1 EXT. X 7/8 -14 INT. THD. (1.1003)				2	1	1								
	5127197	PLUG, 1 EXT. X 3/4 -10 INT. THD. (1.5001)				2	1	1								
	5146646	PLUG, 1 1/4 SQ. SOC. HD. PIPE (12.9550)	1	1	1	2	1	1	1	1	1					
	5130896	PLUG, 5/16 -24 (AIR HTR. MTG.)		2					2		2					
	5144472	PLUG, 5/8 -11X1/2 PRIMED (12.9550)	10	20	6	31	18	18	20		20					
	5142335	# PLUG, 2 VENT (1.2001)		1					1		1					
	5150131	PLUG, 7/16 CUP (SPECIAL)				4										
	9421746	PLUG, 9/16 CUP (9.3550)			2											
	9428477	PLUG, 15/16 CUP (2.7340)	1	1	1	1			1		1					
	5139988	PLUG, 1 CUP (STAINLESS)	5	5	1	8	1	5	5		5					
	5150014	PLUG, 1 1/4 CUP (CORE HOLE)				2										
	5132410	PLUG, 1 5/8 CUP (STAINLESS)	2	2	2	4	2	2	2	2	2					
	5117186	PLUG, 2 CUP (STAINLESS) (1.2001)	10	12	16	24	12	12	12	16	12					

1.1000 CYLINDER BLOCK

FIG	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		1.1001 - BLOCK, CYLINDER (CONT'D)														
	9427705	* PLUG, 2 1/8 CUP	10	11	16	24	12	12	11	16						
	5144559	* PLUG, 2 1/4 CUP	10	11	16	24	12	12	11	16						
	5139989	* PLUG, 2 1/2 CUP	10	11	16	24	12	12	11	16						
	5123862	PLUG, 1 3/8 CUP (SPECIAL)		2	2	4	2	2	2							
	5138646	PLUG, 2 1/2 -16 (SPECIAL)	2	2	4	4	2	2	2	4	2					
	5138659	GASKET (2 1/2 -16 PLUG)	2	2	4	4	2	2	2	4	2					
	141214	PIN, 5/16 X7/16 DOWEL (12.9290)	3	3	4	6	3	3	3		3					
	5123239	& PIN, SPRING (1 LONG)		1	1				1		1					
	103195	& STUD, 3/8 X1 7/16 (4.4050)				4	2	2								
	103647	DRAINCOCK, 1/4 (12.9510)				4										
	5140081	PLUG, 3/4 X3/8 RED. PIPE				1										
	5140082	GASKET (ALUMINUM, WITH 5140081 PLUG)				1										
7C	5131432	BEARING, CAMSHAFT END (1.7010)				4	2	2								
7C	5117649	BOLT, CAM INTER-BEARING LOCK (1.7050)				4	2	2								
	5109346	SEAL, INTER-BLOCK				1										
	5186579	RING, SEAL (WATER) (1.2020)				2										
1D	271587	BOLT, 5/8 -18X2 (12.9001) (ITEM 1)				1										
1D	271585	BOLT, 5/8 -18X1 3/4 (12.9001) (ITEM 7)				6										
1C	5135243	BOLT, 3/4 -10X3 1/2 HEX. SOC. (ITEM 3)				2										
1C	5127196	PLUG, 1 EXT. X 7/8 -14 INT. ITEM 6) (1.1003)				2										
1D	5127197	PLUG, 1 EXT. X 3/4 -10 INT. ITEM 5) (1.5001)				2										
	5127952	WASHER, 1.12 O.D.X.755 I.D.				2										
	5126030	SPACER, BOLT (CYLINDER BLOCK JUNCTION)				2										
1D	126023	NUT, 5/8 -18 LOCK (12.9140) (ITEM 2)				1										
	5122961	COVER, WATER HOLE (FRONT) (1.1060)				1										
	5122962	COVER, WATER HOLE (REAR) (1.1060)				1										
	5108216	COVER, OIL HOLE				2										
	5117254	GASKET, WATER HOLE (4.4230)				1										
	179838	BOLT, 3/8 -16X7/8 (12.9001)				4										
	179839	BOLT, 3/8 -16X1 (12.9001)				8										
	5152148	WASHER, 3/8 FLAT COPPER (2.4050)				4										
	103321	LOCKWASHER, 3/8 (12.9200)				8										
		THE FOLLOWING ITEMS ARE SHIPPED LOOSE WITH THE CYLINDER BLOCK REFER TO PLUGGING CHT. 18SP89.														
	9409620	BOLT, 7/16 -14X1 1/8 LK. (1.3112)		3	3	6			3		3					
	5125608	WASHER, 7/16 FLAT (1.3112)		3	3	6			3		3					
	5186579	RING, SEAL (1.2020)					2	2								
	103196	STUD, 3/8 X1 9/16 (12.9117)	2	2	2				2		2					
	103197	STUD, 3/8 X1 13/16 (12.9117)			2	2										
	5152121	STUD, 5/16 -18-24X1 1/2 (2.2005)	10	14	22	28	14	14	14		14					
	103196	STUD, 3/8 - 16 x 24 x 1 9/16	2													

1.1001 - BLOCK, CYLINDER (CONT'D)

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	C	E	F	G	H	I	J	K	L	M	N
	5103045	PIN, 5/16 x 7/1 DOWEL	3													
	141346	PIN, 3/16 X1/2 DOWEL (12.9290)	4	4	4	4		4	4		4					
	5151576	PIN, 1/2 X1 5/8 DOWEL	4	4	4	4	2	2	4		4					
	5121182	PLUG, 1/4 PIPE (12.9550)	7	3					3		3					
	5145014	PLUG, 3/8 PIPE (12.9550)						1								
	5150131	PLUG, 7/16 CUP					2	2								
	9428477	PLUG, 15/16 CUP (2.7340)						2								
	5150014	PLUG, 1 1/4 CUP		1			1	1	1		1					
	5140082	GASKET (ALUMINUM, WITH 5140081 PLUG)						1								
1A	5140081	PLUG, 3/4 X3/8 RED. PIPE						1								
1A	103647	DRAINCOCK, 1/4 (12.9510)	2	2	2		2	2	2		2					
1A	118536	DRAINCOCK, 3/8 (12.9510)	1	1	1				1		1					

@ NOT SERVICED USE FRONT AND REAR ASSEMBLIES. REFER TO 1.1003 FOR ATTACHING PARTS.

MAY BE REQUIRED FOR SOME AIR COMPRESSOR OR OIL COOLER GROUPS.

* REPLACES 5117186 PLUG WHEN REQUIRED FOR OVERSIZE HOLES./

& OBSOLETE

1.1000A AIR BOX DRAINS

1.1100 - TUBE, AIR BOX DRAIN

FIG.	PART NUMBER	NAME AND DESCRIPTION	69	74	76	91	92	97	100	101	102	103	104	105
1A	5138341	* TUBE (DEV. L. 9.56) (1.1130)				3								
1A	5117907	TUBE (DEV. L. 10.76)		1			1	1						
1A	5136229	TUBE (DEV. L. 10.88)			2									
1A	5141673	TUBE (DEV. L. 11.36)					1							
1A	5144320	TUBE (DEV. L. 12.19)							1	1			1	
1A	5121598	TUBE (DEV. L. 12.24)		1										
1A	5134537	TUBE (DEV. L. 12.72)	2											
1A	5117128	TUBE (DEV. L. 13.90)		2										
1A	5144369	TUBE (DEV. L. 14.48) (LEFT FRONT)							1	1			1	
1A	5121598	TUBE (DEV. L. 12.24)		1										
1A	5144327	TUBE (DEV. L. 15.60)							2	2	2	2	2	2
1A	5140975	TUBE (DEV. L. 20)				1								
	191559	CONNECTOR, 5/16 INV. FL. TUBE (12.9460)			2									
	442322	CONNECTOR, 5/16 TUBE, 1/8 PIPE (12.9460)							1	1			1	
	2140045	VENT ASSY.			2									
1A	225815	ELBOW, 5/16 -90 DEG. INV. FL. TUBE (12.9480)	2	4	2	4	2	4	3	1	2	2	3	2
	5145009	PLUG, 1/8 PIPE (CTR. HOLES) (12.9550)	2		2	4								
	137398	NUT, 5/16 INV. FL. TUBE (12.9500)		2		3								
	137398	NUT, 5/16 INV. FL. TUBE (12.9500)		4		3		4	3	1			3	

* NO LONGER AVAILABLE FOR SERVICE.

1.1145 - CLIP, AIR BOX DRAIN TUBE

FIG.	PART NUMBER	NAME AND DESCRIPTION	69	74	76	91	92	97	100	101	102	103	104	105
1A	5140667	CLIP				4								
1A	5163442	CLIP (2.9428)			2									
1A	5176668	CLIP (1.1100)								1				2
1A	3290459	CLIP (2.5220)									1			
1A	5182629	CLIP (12.4080)							1	1	1			
1A	179835	BOLT, 3/8 -16X5/8 (12.9001)			1				1	1	2			
1A	103321	LOCKWASHER, 3/8 (12.9200)			AR				AR	AR	AR			

1.2000 CYLINDER HEAD

1.2001 - HEAD ASSY., CYLINDER

FOR TYPE 97 USE TYPE 29.
FOR COMPONENTS OF SERVICE CYLINDER HEAD ASSEMBLIES REFER TO ASSEMBLY BREAKDOWN, PAGE A1.

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 77	95	96	100	102
2A	5198571	* HEAD ASSY. (4 VALVE) (5102771)(8V)	2				
2A	5102770	HEAD ASSY. (4 VALVE OR TURBO)(12V)		2	2		
2A	5102769	HEAD ASSY. (4 VALVE)(6V)				2	
2A	5199481	HEAD ASSY. (4 VALVE, TURBO)(6V)					2
2C	5137883	HOSE, #5 X 9.5 (2.5149)		2	2		
	5117344	PLATE	8			6	6
2A	5150362	STUD, 3/8 -16/24 X 1 11/16 (5.2020)	16	24	24		12
2A	5150361	GASKET (5.2010)	8			6	6
2A	5121182	PLUG, 1/4 PIPE (2.4015)	20	13	13	4	14
2A	5125237	PLUG, 1/4 HEX. SKT.	7	5	5	10	6
2A	5145010	PLUG, 1/4 PIPE (12.9550)	1				
2A	5145014	PLUG, 3/8 PIPE HEX. SKT. HD. (12.9550)	5	5	5	6	5
2A	5154453	PLUG, 3/8 -16 SPECIAL	12	8	8	14	8
2A	5178976	PLUG, 7/16 -14 SPECIAL (1.3160)	8	14	6	8	8
2A	5150132	PLUG, 3/4 DIA. CUP (1.1001)	2	2	4	4	2
2A	5117186	PLUG, 2 DIA. CUP				2	2
	5142335	PLUG, 2 VENTING, 1/4 & 3/8 PIPE TAP HOLES	2				
	103321	# LOCKWASHER, 3/8 (12.9200)	16				
	117049	# NUT, 3/8 -24 HEX. (12.9120)	16				
	185060	BUSHING, 3/4 X1/4 RED. (12.9570)		2	2		
	143343	ELBOW, 5/16 -90 DEG. (12.9480)		2	2		
		* NOT SERVICED USE PART NUMBER SHOWN IN PARENTHESES AND INCLUDE ITEMS MARKED #.					
	5101377	BOLT, 3/8" – 16 x 1"				12	

1.2002 - GASKET KIT, CYLINDER HEAD OVERHAUL

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 77	95	96	100	102
	5196380	GASKET KIT				AR	AR
	5196381	GASKET KIT	AR				
	5196382	GASKET KIT		AR	AR		

1.2010 - GASKET, CYLINDER HEAD COMPRESSION

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 77	95	96	100	102
1A	5183330	GASKET	8	12	12	6	6
	5103659	GASKET				6	

1.2020 - GASKET SET, CYLINDER HEAD OIL

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 77	95	96	100	102
1A	5119972	RING, SEAL				2	2
1A	5119973	RING, SEAL	2				
1A	5119974	RING, SEAL		2	2		

1.2000 CYLINDER HEAD

FIG.	PART NUMBER	NAME AND DESCRIPTION	77	95	96	100	102
		1.2020 - GASKET SET, CYLINDER HEAD OIL (CONT'D)					
1A	5186579	RING, SEAL (WATER HOLE)	12	20	20	8	8
1A	5186577	RING, SEAL (END WATER HOLES)	6	6	6	6	6
		1.2022 - GASKET, CYLINDER HEAD WATER AND OIL					
1A	5183305	GASKET	2	2	2	2	2
		1.2030 - STUD, CYLINDER HEAD					
	5117003	BOLT	20	28	28	16	16
		1.2050 - COVER, CYLINDER HEAD GOVERNOR HOLE					
2A	5150268	COVER (PLAIN)	6	6	6	2	6
2A	5131486	COVER (1/4 TAPPED HOLE) (7.4597)	AR	AR	AR		AR
2A	5179709	WASHER, 1/4 COPPER (2.7175)	12	12	12		12
2A	180016	BOLT, 1/4 -20X1/2 (12.9001)	12	12	12		12
2A	186676	BOLT, 1/4 -20X5/8 (12.9001)	AR	AR	AR		AR
	5104089	BOLT, 1/4 - 20x1/2 W/SEAL PATCH				4	
	103319	LOCKWASHER 1/4 (12,9200)				4	
		1.2060 - GASKET, CYLINDER HEAD GOVERNOR HOLE COVER					
2A	5123812	GASKET	6	6	6	2	6

1.2000 CYLINDER HEAD

1.2001 - HEAD, CYLINDER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5102765	HEAD ASSY. (4 VALVE) (6V-71)	1													
	5102771	HEAD ASSY. (4 VALVE OR TURBO) (8V & 16V-71)		1												
	5102770	HEAD ASSY. (4 VALVE OR TURBO) (12V-71)			1											
	5198218	HEAD ASSY. (2 VALVE) (6V-71)				1										
	5198219	HEAD ASSY. (2 VALVE) (12V-71)					1									
	5199481	HEAD ASSY. (4 VALVE OR TURBO) (6V-71)						1								
	5199719	* HEAD ASSY. (4 VALVE) (NON-TURBO) (COMPLETE) (8V-71)							1							
	5199717	* HEAD ASSY. (4 VALVE) (NON-TURBO) (COMPLETE) (12V-71)								1						
		THE FOLLOWING ITEMS ARE ASSEMBLED TO THE CYLINDER HEAD														
	5113773	# SLEEVE, PILOT .70 LG (5100929)	2	2	2			2	2	2						
	5142549	PLUG, 3/4 PIPE (12.9550)	2	2	4	2	2	2	2	4						
	5193541	PLUG, FUSE	1	1	1	1	1	1	4	1						
	5154453	PLUG, 3/8 -16 SL. HDLS.							4	4						
	5145014	PLUG, 3/8 PIPE (12.9550)							3	3						
	5117186	PLUG, CUP 2 DIA.							2							
	5121182	PLUG, PIPE 1/4 (2.4015)							9	13						
	5125237	PLUG, 1/4 HEX. SKT. HD.							5	5						
	5178976	PLUG, 7/16 -14 SPECIAL (1.3160)							4	4						
	5150132	PLUG, 3/4 DIA. CUP (1.1001)							2	16						
	5150361	GASKET, PLATE (5.2010)								6						
	103321	LOCKWASHER, 3/8 (12.9200)								12						
	117049	NUT, 3/8 -24 (12.9120)								12						
	5172874	NOZZLE, WATER (SINGLE OUTLET) (1.2005)	4	4	4	4	4	4	4	4						
	5111332	NOZZLE, WATER (DOUBLE OUTLET) (1.2005)	4	6	10			4	6	10						
	5172875	NOZZLE, WATER (DOUBLE OUTLET) (1.2005)				4	10									
	5199527	TUBE KIT (INCLUDES RING 5160037) (1.2045)	3	4	6	3	6	3	4	6						
	5104701	RING (1.2046)	3	4	6	3	6	3	4	6						
	5111340	ARM ASSY. (1.8060)							4	6						
	5111343	ARM ASSY. (1.8060)							4	6						
	5179954	ARM ASSY. (1.8080)							4	6						
	5150322	SHAFT ASSY. (1.8160)							4	6						
	5150324	BRACKET (1.8170)							8	12						
	5150325	BOLT (1.8170)							8	12						
	5151601	LOCKNUT (1.8180)							20	30						
	5128640	ROD (1.8180)							12	18						
	5186858	SPRING (1.8190)							12	18						
	5150302	SEAT (1.8200)							12	18						
	5123250	SEAT, CAM FOLLOWER (1.8210)							12	18						

1.2000 CYLINDER HEAD

1.2001 - HEAD, CYLINDER (CONT'D)

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5150303	RETAINER (1.8250)							12	18						
	5115087	FOLLOWER ASSY. (1.8260)							12	18						
	5150298	GUIDE, CAM FOLLOWER (1.8300)							4	6						
	443603	BOLT, 1/4 -20X3/4 (12.9001)							8	12						
	120380	LOCKWASHER, 1/4 (12.9200)							8	12						
	5195167	VALVE, EXHAUST (1.8310)							16	24						
	5129919	GUIDE, EXHAUST VALVE (1.8320)	12	16	24			12	16	24						
	5120930	GUIDE, EXHAUST VALVE (1.8320)				6	12									
	5131096	INSERT, EXHAUST VALVE (1.8330)				6	12									
	5101101	INSERT, VALVE (1.8330)	12	16	24			12	16	24						
	5117561	SPRING, VALVE (1.8340)							16	24						
	5117565	BRIDGE, EXHAUST VALVE (1.8343)							8	12						
	5129101	SCREW, ADJUSTING (1.8343)							8	12						
	5117564	GUIDE, EXHAUST VALVE BRIDGE (1.8345)							8	12						
	5117563	CAP, VALVE SPRING (1.8350)							16	24						
	5117562	SEAT (1.8360)							16	24						
	5111337	LOCK, VALVE SPRING SEAT (1.8370)							32	48						
	5117369	CONNECTOR (2.4030)							8	12						
	5125108	WASHER, 7/16 X3/4 FLAT (2.4050)							8	12						
	5150362	STUD, 3/8 -16X1 11/16 (5.2020)							8	12						
	5112899	STUD, 7/16 -14X2 3/22 (6.1020)							5	7						
		# EFFECTIVE WITH 1974 HEAD ASSYS. USE NUMBER SHOWN IN PARENTHESES. THE FOLLOWING ITEMS ARE SHIPPED LOOSE WITH THE CYLINDER HEAD.														
	5117344	PLATE	3	4		3	6		4	6						
	5150361	GASKET (5.2010)	3	4		3	6		4	6						
	103321	LOCKWASHER, 3/8 (12.9200)	6	8		6	12		8	12						
	117049	NUT, 3/8 -24 HEX. (12.9120)	6	8		6	12		8	12						
	5125237	PLUG, 1/4 HEX. SKT. HD.	6	5	5	5	5		5	5						
	5154453	PLUG, 3/8 -16 SPL.	4	4	4	4	4		4							
	5117186	PLUG, 2 DIA. CUP	2	2		2	2		2							
	5150132	PLUG, 3/4 DIA. CUP (1.1001)	2	2	2	2	2		2	2						
	5178976	PLUG, 7/16 -14 SPECIAL (1.3160)	4	4	4	4	4		4	4						
	5117564	GUIDE, EXHAUST VALVE BRIDGE (1.8345)	6	8	12											
	5117562	SEAT, EXHAUST VALVE SPRING (1.8360)	12	16	24											
	5121182	PLUG, 1/4 PIPE (2.4015)	7	9	13	7	13		9	13						
	5117369	CONNECTOR (2.4030)	6	8	12	6	12		8							
		* OBSOLETE														

1.2001 - THE FOLLOWING ITEMS ARE SHIPPED

LOOSE WITH THE CYLINDER HEAD.

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5125108	WASHER (2.4030)	6	8	12	6	12		8							
	5129845	CONNECTOR, .080 RESTRICTED		1	1											
	5150362	STUD, 3/8 -16/24 X 1 11/16 (5.2020)	6	8	12	6	12		8							

1.2000 CYLINDER HEAD

FIG	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	1.2001 -	THE FOLLOWING ITEMS ARE SHIPPED (CONT'D)														
	5112899	STUD, 7/16 -16/14 X 2 3/32 (6.1020)	4	5	7	4	7		5							
	5145014	PLUG, 3/8 PIPE HEX. SKT. HD. . . . . (12.9550)	3	3	2	3	3		3	1						
	18SP80	CYLINDER HEAD ASSY., INSTRUCTION . . DRAWING FOR 2 VALVE				1	1									
	18SP85	CYLINDER HEAD ASSY., INSTRUCTION . . DRAWING FOR 4 VALVE	1	1	1			1	1	1						

1.2000A ENGINE LIFTER BRACKET

1.2070 - BRACKET, ENGINE LIFTER FRONT

FOR TYPE 58 USE TYPE 166.
FOR TYPE 59 USE TYPE 167.

FIG.	PART NUMBER	NAME AND DESCRIPTION	32	33	34	37	38	39	45	47	54	55	57	60
2E	5109900	BRACKET (ITEM 2)	1					1	1				1	
2E	5128441	BRACKET (ITEM 3)		1	1	1	1							
13A	5126975	BRACKET								1				
2E	5133362	BRACKET (ITEM 2)												1
	190270	BOLT, 1/2 -13X4 1/4 (12.9001)						1	1	1			1	1
	223435	BOLT, 5/8 -11X1 3/4 (12.9001)		2	2	2	2	1	1	1			1	1
	103323	LOCKWASHER, 5/8 (12.9200)						1	1	1			1	1
	103325	LOCKWASHER, 5/8 (12.9200)		AR	AR	AR	AR	AR	AR	AR			AR	AR

1.2080 - BRACKET, ENGINE LIFTER REAR

FIG.	PART NUMBER	NAME AND DESCRIPTION	32	33	34	37	38	39	45	47	54	55	57	60
2E	5137761	BRACKET (ITEM 4)	2			2	1				4	4		2
2E	5119379	BRACKET (ITEM 1) (1.2070)		2				2						
	5126230	BRACKET							1					
	5163906	SPACER (13/32 X13/16 X.25) (7.1598)										3		
	186615	BOLT, 3/8 -16X1 1/8 (12.9001)		4										
	186612	BOLT, 3/8 -16X1 3/8 (12.9001)							1					
	186317	BOLT, 3/8 -24X5 (12.9001)							2					
	454533	BOLT, 7/16 -14X1 1/8 (12.9001)	4			4	2				4	4		4
	180152	BOLT, 7/16 -14X1 7/8 (12.9001)										4		
	103342	WASHER, 7/16 (12.9190)				AR						AR		AR
	103321	LOCKWASHER, 3/8 (12.9200)		AR					AR					
	103322	LOCKWASHER, 7/16 (12.9200)				AR					AR	AR		AR

1.3000 CRANKSHAFT

1.3001 - CRANKSHAFT ASSY.

A CRANKSHAFT ASSY. INCLUDES PLUGS AND DOWELS IN 1.3001 AND OIL PUMP DRIVE KEY IN 4.1310. THE 16V CRANKSHAFT INCLUDES ONLY ITEMS SHOWN IN 1.3001.

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3A	5146733	CRANKSHAFT ASSY. (6V)	1											1
3A	5144275	CRANKSHAFT ASSY. (8V)		1			1	1					1	
3A	5146734	CRANKSHAFT ASSY. (12V)			1						1			
	5198633	CRANKSHAFT ASSY. (FRONT HALF) (16V)				1			1	1		1		
	5199308	CRANKSHAFT ASSY. (REAR HALF) (16V)				1			1	1		1		
	5177528	DOWEL	2	2	2	2	2	2	2	2	2	2	2	2
3A	444687	PLUG, 1/8 PIPE (12.9550)	3	4	6	8	4	4	8	8	6	8	4	3
	5121182	PLUG, 1/4 PIPE (2.4015)					1	1						
	9409626	BOLT, 5/8 -18X2 (12.9001)				10			10	10		10		
	9416721	NUT, 5/8 -18 (12.9120)				10			10	10		10		
	120502	KEY, WOODRUFF 3/16 x 7/8												1

1.3040 - SEAL, CRANKSHAFT OIL - FRONT

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3A	5115454	SEAL, OIL	1	1	1		1	1			1		1	1
	5143108	SEAL, OIL (SUBMERCIBLE)		1			1	1						
3A	5114335	@ SEAL, OIL (SINGLE LIP) (1.3060)				1			1	1		1		
3A	5197860	# SEAL, OIL (1.3060)				1			1	1		1		
	5198908	SLEEVE (.82 L.) (USE WITH 5197860)				1			1	1		1		

@ THRU 16VA-2452.
# EFF. WITH 16VA-2453 FOR ENGINES EQUIPPED WITH TRUNNION MOUNTS ONLY.

1.3050 - SLINGER, CRANKSHAFT OIL - FRONT

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3A	5150174	& SLINGER	AR	AR	AR		AR	AR			1		AR	

& USED WHEN OIL PUMP IS MOUNTED TO MAIN BEARING CAP ON 6 AND 8V ENGINES.

1.3055 - SPACER, CRANKSHAFT FRONT OIL SEAL

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
	5187760	% SPACER (.55 L.) (1.3275)	1	1										
	5122983	% SPACER (2 L.)	1	1										
	5132951	+ SPACER (2.18 L.)	1	1	1						1			1
	5122214	SPACER (2.55 L.)	1	1			1							
	5151420	SPACER (2.81 L.)	1	1									1	
	5122541	SPACER (3.06 L.)	1	1										

% USED TOGETHER ON MARINE UNITS.
+ TYPE 25 FOR 1200 TO 1500 RPM GENERATOR SETS ONLY.

1.3000 CRANKSHAFT

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	49	53	54
	1.3057 -	WASHER, CRANKSHAFT CAP RETAINER - FRONT												
	5160380	# WASHER (1 3/4 O.D.)	1	1	1		1		1	1	1			
	5157930	# WASHER (2 3/8 O.D.) (1.3290)	1	1	1				1	1	1			
	5132357	# WASHER (2.88 O.D.) (1.3290)						1						
	5130479	# BOLT, 1 -14X1.840 SPECIAL (1.3290)						1						
	5153623	# BOLT, 1 -14X2 1/4 (1.3290)	1	1	1				1	1	1			
	5160266	# BOLT, 1 -14X2 3/4 (1.3290)	1	1	1				1	1	1			
	5120016	# BOLT, 1 -14X3 1/2 (1.3290)	1	1	1				1	1	1			
	5183006	# BOLT, 1 -14X4 (1.3290)			1						1			
		# USE ONLY WHEN PULLEY IS NOT USED.												
	1.3058 -	CAP, CRANKSHAFT - FRONT												
	5112608	# & CAP	1	1	1	1	1	1	1	1	1			
	5160302	# CAP	1	1	1	1	1	1	1	1	1			
		# USE ONLY WHEN PULLEY IS NOT USED. & NOT SERVICED USE 5137103 AND INCLUDE (1) 5157930 WASHER.												
	1.3060 -	SEAL, CRANKSHAFT OIL - REAR												
		USED WITH FLYWHEEL HOUSING IN 1.5001												
3A	5127821	SEAL (DOUBLE LIP) (INDUSTRIAL MODELS)	1	1	1						1			
3A	5114335	SEAL (SINGLE LIP, STD.) (INDUSTRIAL MODELS)	1	1	1		1	1			1		1	1
3A	5197860	SEAL (SINGLE LIP, O.S.) (USE WITH 5197159 SLEEVE)	AR	AR	AR						AR			
3A	5196927	SEAL (DOUBLE LIP, O.S.) (USE WITH 5197159 SLEEVE)	AR	AR	AR						AR			
3A	5135150	SEAL (DOUBLE OPPOSED LIP)				1								
3A	5198159	SEAL (DOUBLE LIP, O.S.) (USE WITH 5198158 SLEEVE)				AR								
3A	5114802	SEAL (SINGLE LIP, STD.)							1	1		1		
3A	5194462	SEAL (SINGLE LIP, O.S.) (USE WITH 5198158 SLEEVE)							AR	AR				
	1.3065 -	SPACER, CRANKSHAFT REAR OIL SEAL												
	5192456	% SPACER	AR	AR	AR				AR	AR	AR		AR	
		% CAN BE USED ONLY WITH SINGLE LIP OIL SEAL.												
	1.3066 -	SLEEVE, CRANKSHAFT REAR OIL SEAL												
	5197159	SLEEVE (USE WITH O.S. SEAL)	AR	AR	AR						AR		AR	
	5198158	SLEEVE (USE WITH O.S. SEAL)				AR			AR	AR				

1.3000 CRANKSHAFT

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES											
			23	24	25	26	27	28	29	33	37	49	53	84
		1.3112 - STABILIZER, CRANKSHAFT MAIN BEARING CAP (CONT'D)												
	9405620	* BOLT, 7/16 -14X1 1/8 LOCK	5	7	11	6			6	6	11	6		
1B	9409629	% # BOLT, 7/16 -14X1 1/8 LOCK		3	3								3	
	5125608	* WASHER (7/16 FLAT)	5	7	11	6			6	6	11	6		
	5125608	% # WASHER (7/16 FLAT)		3	3								3	

+ THRU 6VA-061, 8VA-024, 12VA-039.
* EFFECTIVE WITH 6VA-062, 8VA-025, 12VA-040, 16VA-541 AND THRU 6VA-915, 8VA-356, 12VA-234.
@ EFFECTIVE WITH 12VA-5750, 16VA-541
# EFFECTIVE WITH 8VA-83550 FOR TURBOCHARGED 8V ONLY, TYPE 24.
% EFFECTIVE WITH 12VA-5750.
= NOT SERVICED, USE 5102413, 5102370 ,5102374, AND INCLUDE 5102373 TO ASSURE INTERCHANGEABILITY.

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES											
			23	24	25	26	27	28	29	33	37	49	53	84
		1.3115 - STABILIZER KIT, MAIN BEARING CAP												
	5149294	* STABILIZER KIT		1	1	1			1	1	1	1		

* A STABILIZER KIT CONSIST OF (1) 5102370 STABILIZER, (1) 5102413 STABILIZER, (4) 5102374 BOLTS AND (4) 5102373 WASHERS.

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES											
			23	24	25	26	27	28	29	33	37	49	53	84
		1.3140 - BOLT, CRANKSHAFT MAIN BEARING CAP												
3A	5121263	+ BOLT (6.24 L.) (1.2030)	8	10	14									
3A	5116353	= BOLT (6.24 L.)	8	10	14	20	10	10	20	20	14			
3A	5116353	@ BOLT (6.24 L.)			10	12			12	12	10	12		
3A	5125198	- * #$BOLT (6.54 L.)	8	10	14	8			8	8	14	8		
3A	5125198	% #$BOLT (6.54 L.)		4	4						4		4	
3A	5102374	BOLT (6.62 L.)	8	10	14	8			8	8	14	8		8
3A	5102374	BOLT (6.62 L.)		4	4						4		4	
		THICK)												
3A	5102373	WASHER (.694 I.D.X1.125 O.D.X.180 . .	8	10	14	20	10	10	20	20	14			8
		THICK)												
3A	5102373	WASHER (.694 I.D.X1.125 O.D.X.180 . .				12			12	12		12		
		THICK)												
	5175505	+ WASHER (.66 I.D.X1.24 O.D.) (1.2040)	8	10	14						14			
	5124988	= $ WASHER (.66 I.D.X1.35 O.D.X.0205 .	8	10	14	20	10	10	20	20	14			
		THICK)												
	5124988	@ $ WASHER (.66 I.D.X1.35 O.D.X.205 . .				12			12	12		12		
		THICK)												

+ THRU 6VA-061, 8VA-024, 12VA-039.
= EFFECTIVE WITH 6VA-916, 8VA-357, 12VA-235, 16VA-001 WITHOUT

1.3000 CRANKSHAFT

1.3090 - SHELL, CRANKSHAFT MAIN BEARING

A SHELL SET CONSISTS OF ONE UPPER AND ONE LOWER BEARING SHELL.

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3A	5117010	SHELL, UPPER (STD.)	4	5	7	10	5	5	10	10	7	10	5	
3A	5117011	SHELL, LOWER (STD.)	4	5	7	10	5	5	10	10	7	10	5	
3A	5196331	SHELL, UPPER (.002 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
3A	5196332	SHELL, LOWER (.002 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
3A	5196334	SHELL, UPPER (.010 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
3A	5196335	SHELL, LOWER (.010 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
3A	5196337	SHELL, UPPER (.020 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
3A	5196338	SHELL, LOWER (.020 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
3A	5196340	SHELL, UPPER (.030 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
3A	5196341	SHELL, LOWER (.030 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	
	5196319	SHELL SET (STD.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
	5196330	SHELL SET (.002 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
	5196333	SHELL SET (.010 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
	5196336	SHELL SET (.020 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
	5196339	SHELL SET (.030 U.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR

1.3100 - WASHER, CRANKSHAFT MAIN BEARING THRUST

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3A	5117005	WASHER (STD.)	4	4	4	4	4	4	4	4	4	4	4	4
3A	5196753	WASHER (.005 O.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	4
3A	5196754	WASHER (.010 O.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	4
3A	141346	PIN, 3/16 X1/2 DOWEL (12.9290)	4	4	4	4	4	4	4	4	4	4	4	4

1.3110 - CAP, CRANKSHAFT MAIN BEARING

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3A	5196317	CAP	4	5	7	10	5	5	10	10	7	10	5	4
	5117502	CAP (UNFINISHED)	4	5	7	10	5	5	10	10	7	10	5	4

1.3112 - STABILIZER, CRANKSHAFT MAIN BEARING CAP

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
1C	5124401	+ STABILIZER (ITEM F)	2											
1C	5124402	+ STABILIZER (ITEM F)		2										
1C	5124403	+ STABILIZER (ITEM F)			2									
1B	5125299	* = STABILIZER (ITEM C)		3	3	3			3	3	3	3		
1B	5125299	@ # = STABILIZER (ITEM C)		1	1	2			2	2	1	2	1	
1B	5125161	@ # = STABILIZER (ITEM B)		1	1	2			2	2	1	2	1	
1B	5125164	* STABILIZER (ITEM D)			1						1			
1B	5125165	* STABILIZER (ITEM E)			1						1			
3A	5102413	STABILIZER (ITEM C)		3	3	3			3	3	3	3		
3A	5102413	STABILIZER (ITEM C)		1	1	2			2	2	1	2	1	
3A	5102370	STABILIZER (ITEM B)		1	1	2			2	2	1	2	1	

1.3000 CRANKSHAFT

1.3140 - BOLT, CRANKSHAFT MAIN BEARING CAP (CONT'D)

STABILIZERS AND THRU 12VA-5789, 16VA-540.
@ EFF. WITH 12VA-5790, 16VA-541.
* EFF. WITH 6VA-062, 8VA-025, 12VA-040, 16VA-541 AND THRU 6VA-915, 8VA-356, 12VA-234.
$ NOT SERVICED USE 5102374 BOLT AND 5102373 WASHER & REWORK STABILIZER PER BULLETIN 31-D-75.

1.3145 - GEAR, CRANKSHAFT TIMING

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3A	5117102	GEAR (R.H. HELIX) (R.H. ENGINE ROTATION) (REAR	1	1	1		1	1		1	1		1	1
3A	5122101	GEAR (L.H. HELIX) (L.H. ENGINE ROT.)	1	1	1						1			
3A	5124719	GEAR (R.H. HELIX) (R.H. ENGINE ROTATION) (REAR)				1			1			1		
3A	5124720	GEAR (L.H. HELIX) (L.H. ENGINE ROTATION) (REAR)				1			1					
	5126035	GEAR (R.H. HELIX) (R.H. ENGINE ROTATION) (FRONT)				1			1			1		
	5126034	GEAR (L.H. HELIX) (L.H. ENGINE ROTATION) (FRONT)				1			1					
	5131565	* GEAR (R.H. HELIX) (R.H. ENGINE ROTATION) (FRONT)								1				
	5126369	BOLT, 5/16 -24X1 1/4				6			6	6		6		
3A	9409035	BOLT, 3/8 -24X1 LOCK (12.9001)	6	6	6	6	6	6	6	6	6	6	6	8

* USED WITH FRONT MOUNTED LUBE OIL PUMP TYPE 72.

1.3146 - KIT, VIBRATION DAMPER RECONDITIONING

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3B	5198306	KIT (INCLUDES SPRINGS, SPACERS, NUTS AND BOLTS WHICH ARE NOT SERVICED SEPARATELY)				1			1	1		1		

1.3147 - DAMPER, CRANKSHAFT FRONT GEAR

NOTE COMPONENTS OF DAMPER ASSYS. ARE NOT SERVICED SEPARATELY. REFER TO RECONDITIONING KIT IN 1.3146.

FIG.	PART NUMBER	NAME AND DESCRIPTION	23	24	25	26	27	28	29	33	37	45	53	54
3B	5137566	DAMPER ASSY.				1			1	1		1		
	5130337	@ DAMPER ASSY.				1			1	1		1		
	5126368	BOLT, 3/8 -24X1/2 HEX. SOCKET				6			6	6		6		

1.3000C CRANKSHAFT PULLEY

1.3280 - PULLEY, CRANKSHAFT

FIG.	PART NUMBER	NAME AND DESCRIPTION	139	142	146	147	148	149	152	153	154	160	161
5A	5122211	PULLEY (9 DIA., 3 GROOVES, 7.50 DIA., 1 GROOVE)								1			
5A	5128122	PULLEY (7.50 DIA., 1 GROOVE, 6.16 DIA., 3 GROOVES)	1										
5A	5127246	PULLEY (7.50 DIA., 2 GROOVES, 6.84 DIA., 3 GROOVES)		1									
5A	5126964	# PULLEY (7.28 DIA., 2 GROOVES, 5.00 DIA., 2 GROOVES)			1								
5A	5128954	PULLEY (7.50 DIA., 2 GROOVES, INCLUDES HUB)				1							
5A	5124532	PULLEY (5 GROOVES, 3-6.84 AND 2-7.50 DIA.)					1						
5A	5121889	* PULLEY ASSY. (7.28 DIA., 3 GROOVES, 7.50 DIA., 1 GROOVE)						1					
5A	5129984	PULLEY (7.28 DIA., 3 GROOVES, 7.50 DIA., 1 GROOVE)							1				
5A	5129383	PULLEY (6.16 DIA., 3 GROOVES, 7.50 DIA., 2 GROOVES)									1		
5A	5129777	PULLEY (7.28 DIA., 3 GROOVES)										1	
5A	5118364	@ PULLEY (6.62 DIA., 1 GROOVE)											1
	5156295	# PIN, DOWEL (.434X1) (1.3230)						1					
	5131724	KEY, 3/8 X1 WOODRUFF				1							
5B	5131724	KEY, 3/8 X1 WOODRUFF	2	2	2		2	2	2	2	2	2	2

# NO LONGER AVAILABLE FOR SERVICE.
* NOT SERVICED. USE 5138174 AND INCLUDE 1-5182310 HUB, 1-5122481 CONE, AND 5-181394 BOLTS.
@ PART OF 5121889 PULLEY ASSY.

1.3290 - RETAINER, CRANKSHAFT PULLEY

FIG.	PART NUMBER	NAME AND DESCRIPTION	139	142	146	147	148	149	152	153	154	160	161
5A,B	5157930	RETAINER (2 3/8 O.D.)	1	1	1	1	1	1	1	1	1	1	1
5A,B	5153623	BOLT, 1 -14X2 1/4 (12.9001)	1	1	1		1	1	1	1		1	
5A	5160266	BOLT, 1 -14X2 3/4									1		
5A	273044	BOLT, 1 -14X3 (12.9001)											1
5A	5120016	BOLT, 1 -14X3 1/2 (12.9001)				1							

1.3295 - CONE, CRANKSHAFT PULLEY

FIG.	PART NUMBER	NAME AND DESCRIPTION	139	142	146	147	148	149	152	153	154	160	161
5A	5135151	CONE, 13/16 L. (1.3240)						1	2				
	5187760	SPACER, 3 DIA. (1.3275)						1	1				

1.3000D CRANKSHAFT PULLEY BELT

1.3320 - BELT, CRANKSHAFT PULLEY DRIVE

SIZES GIVEN ARE EFFECTIVE LENGTH AT WIDTH SHOWN.
MS. INDICATES MILITARY STANDARD .

			TYPES										
FIG	PART NUMBER	NAME AND DESCRIPTION	184	203	204	205	206	207	208	209	210	211	212
	5111470	BELT, BILGE PUMP (45 L., .500 W.)	1										
13A	5133760	BELT SET (3 BELTS, 48 L., .500 W.)		1									
13A	5133763	BELT, BILGE PUMP (45 L., .500 W.)			1								
13A	5133765	BELT SET (3 BELTS, 48 L., .500 W.)				1							
13A	5133768	BELT SET (3 BELTS, 55 L., .500 W.)					1						
13A	5133767	BELT SET (3 BELTS, 62 L., .500 W.)						1					
13A	5133770	BELT SET (3 BELTS, 64 L., .500 W.)							1				
13A	5133769	BELT SET (3 BELTS, 62 L., .500 W.)								1			
13A	5133771	BELT SET (3 BELTS, 66 L., .500 W.)									1		
13A	5133764	BELT SET (3 BELTS, 65 L., .500 W.)										1	
13A	5133828	BELT SET (3 BELTS, 65 L., .500 W.)											1

1.4000A FLYWHEEL

1.4001 - FLYWHEEL ASSY.

FOR TYPE 60 USE TYPE 851.
INCLUDES GEAR IN 1.4010.
(C) INDICATES A CHAMFERED ASSY.
NC IS NON-CHAMFERED.

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 15	17	50	64	76	81	83	93	99	108	152	161
6A	5137697	FLYWHEEL ASSY. (SAE #1) (NC)	1											
6A	5129650	FLYWHEEL ASSY. (SAE #1) (C)		1										
6A	5174916	FLYWHEEL ASSY. (SAE #1) (NC)			1									
6A	5171840	FLYWHEEL ASSY. (SAE #1) (NC)				1								
6A	5110969	FLYWHEEL ASSY. (SAE #1) (INCLUDES PLUG) (NC)					1							
6A	5179061	FLYWHEEL ASSY. (SAE #1) (NC)						1						
6A	5174748	FLYWHEEL ASSY. (SAE #1) (NC)							1					
6A	5177025	FLYWHEEL ASSY. (SAE #2) (NC)								1				
6A	5182595	FLYWHEEL ASSY. (SAE #1) (NC)										1		
6A	5181657	FLYWHEEL ASSY. (SAE #1) (NC)											1	
6A	5181673	FLYWHEEL ASSY. (SAE #2) (NC)												1
	444687	PLUG, 1/8 PIPE (12.9550)					1							
6A	5120753	PLATE, FLYWHEEL SCUFF (BOLT RETAINER) (2 7/8 I.D.)		1	1				1	1			1	1
6A	9409532	BOLT, 9/16 -18X2 LOCK (12.9001)				6							6	6
6A	9410925	BOLT, 9/16 -18X2 1/4 LOCK (12.9001)	6	6	6		6	6				6		
6A	9412015	BOLT, 9/16 -18X2 1/2 LOCK (12.9001)								6				
6A	9411631	BOLT, 9/16 -18X2 3/4 LOCK (12.9001)							6					

1.4010 - GEAR, FLYWHEEL RING

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 15	17	50	64	76	81	83	93	99	108	152	161
6A	5184773	GEAR, 118 TEETH (NON-CHAMF.)	1			1	1	1	1			1	1	
6A	5166664	GEAR, 118 TEETH (R.H. CHAMF.)		1	1						1			
6A	5188030	GEAR, 102 TEETH (NON-CHAMF.)								1				1

1.4040 - BEARING, CLUTCH PILOT

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 15	17	50	64	76	81	83	93	99	108	152	161
	907594	BEARING (N.D. Z99606X1C)		1		1	1							
	954421	* BEARING (N.D. 7635L1C)						1						
	906986	BEARING (N.D. Z99506PLR1C)										1		
	907302	BEARING (N.D. Z99605X1978)								1				

* OBSOLETE

1.4045 - RETAINER, CLUTCH PILOT BEARING

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 15	17	50	64	76	81	83	93	99	108	152	161
	5120753	RETAINER		1		1		1						
	2190970	RETAINER					1							
	5176427	RETAINER						1				1		

1.5000A FLYWHEEL HOUSING

1.5001 - HOUSING, FLYWHEEL

FOR TYPE 178, USE TYPE 188.
A HOUSING DOES NOT INCLUDE OIL SEAL.

			TYPES											
FIG.	PART NUMBER	NAME AND DESCRIPTION	184	187	188	189	192	197	200	206	210	214	219	223
	5132454	HOUSING (SAE #2)			1									
6A	5117225	HOUSING (SAE #2) (ALUMINUM)	1											
6A	5124355	HOUSING (SAE #2)		1										
6A	5117223	* HOUSING (SAE #1)			1	1				1				
6A	5123293	* HOUSING (SAE #1)					1							
6A	5117222	HOUSING (SAE #1/2)						1	1					
6A	5129014	HOUSING (SAE #1) (DUAL STARTER PADS)									1			
6A	5123633	HOUSING (SAE #0)										1		
6A	5126503	# HOUSING (SAE #1)											1	
6A	5127926	@ HOUSING (SAE #2) (ALUMINUM)												1
6A	5117362	& CAP (SQUEEZE TYPE) (4.5010)				1				1	1			
6A	5173935	PLUG, 1/2 -13 STD. HOLS. PIPE		4										
	5145012	PLUG, 1/2 PIPE (12.9550)	1			1				1				1
	5142549	PLUG, 3/4 PIPE (12.9550)	1		1		1	1	1		1	1	1	1
	5111798	PLUG, 1 PIPE (12.9550)		1	2	1	1	1	1	1	1	1	1	
6A	5146646	PLUG, 1 1/4 PIPE (12.9550)			1	1	1	1	1	1	1	1	1	
6A	5117186	PLUG, 2 DIA. CUP (1.2001)				1					1			
	5109668	PLUG, 3 5/8 DIA. CUP									1			
	5125193	STUD, 3/8 -24X4.94 (1.5050)						1						
	5124937	STUD, 3/8 -16X5.20 (1.5050)						1						
6A	186273	BOLT, 5/16 -18X4 1/4 (12.9001)				2				2				
6A	215510	BOLT, 5/16 -18X5 3/4 (12.9001)				2				2				
6A	9409028	BOLT, 3/8 -16X1 LOCK (12.9001)	6	6	6	6	6	6	6	6	6	6	6	6
6A	179839	BOLT, 3/8 -16X1 (12.9001)	2	2	2	2	2	2	2	2	2	2	2	2
	186622	BOLT, 3/8 -16X1 1/4 (12.9001)	1	1	1	1	1	1	1	1	1	1	1	1
6A	186282	BOLT, 3/8 -16X3 1/4 (12.9001)										1		
6A	186309	BOLT, 3/8 -24X3 1/4 (12.9001)				4				4	4			
6A	189330	BOLT, 3/8 -24X3 3/4 (12.9001)				3				3	3			
6A	5121466	BOLT, 3/8 -24X3 7/8 (12.9001)	7	7	7		7	7	7			7	7	7
	9409240	BOLT, 1/2 -13X3 (12.9001)	6	6	6	6	6	6	6	6	6		6	6
	5138619	WASHER, 25/64 X3/4 X.083 FLAT	6	6	6		6	6			6	6		6
	103341	WASHER, 3/8 FLAT (12.9190)				AR			AR	AR			AR	
	103343	WASHER, 1/2 FLAT (12.9190)										2		
	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR	10	AR	AR	AR	AR	AR	AR	AR	AR	AR
	103323	LOCKWASHER, 1/2 (12.9200)	6	6		6	6	6	6	6	6	6	6	6
	117049	NUT, 3/8 -24 HEX. (12.9120)						2						

* NOT SERVICED, USE 5132454 AND INCLUDE 1-5146646 PLUG TO ASSURE INTERCHANGEABILITY

@ NOT SERVICED, USE 5142861 AND INCLUDE (1) EACH 5169907 SHIM AND 5131755 WASHER TO ASSURE INTERCHANGEABILITY.

NOT SERVICED, USE 5145103.

& FOR USE IN UNITS EQUIPPED WITH TORQUE CONVERTER.

1.5000A FLYWHEEL HOUSING

FIG	PART NUMBER	NAME AND DESCRIPTION	184	187	188	189	192	197	200	206	210	214	219	223
		1.5010 - GASKET, FLYWHEEL HOUSING												
6A	5117173	GASKET	1	1		1	1	1	1	1	1	1	1	1
	5102550	GASKET			1									
		1.5030 - COVER, FLYWHEEL HOUSING LARGE HOLE												
6A	5122281	COVER	2	2	1	2	2	2	2	2	2	2	2	2
6A	179857	BOLT, 7/16 -14X1 (12.9001)	2	2	1	2	2	2	2	2	2	2	2	2
6A	122408	BOLT, 1/2 -13X1 (12.9001)	8	8	4	8	8	8	8	8	8	8	8	8
	5125108	WASHER (7/16 COPPER) (12.9190)	2	2	2	2	2	2	2	2	2	2	2	2
6A	103343	WASHER, 1/2 (12.9190)	2	2		2	2	2	2	2	2	2	2	2
6A	103322	LOCKWASHER, 7/16 (12.9200)	AR	AR		AR	AR	AR	AR	AR	AR	AR	AR	AR
6A	103323	LOCKWASHER, 1/2 (12.9200)	AR	AR	8	AR	AR	AR	AR	AR	AR	AR	AR	AR
		1.5040 - GASKET, FLYWHEEL HOUSING LARGE HOLE COVER												
6A	5117061	GASKET	2	2	2	2	2	2	2	2	2	2	2	2
		1.5050 - COVER, FLYWHEEL HOUSING SMALL HOLE												
6A	5122219	COVER	3	3	2	3	3	3	3	3	2	3	3	3
	5130376	COVER (1/2 TAPPED HOLE)	AR	AR		AR	AR	AR	AR	AR	AR	AR	AR	AR
	5154669	COVER									1			
	5124937	STUD (3/8 -16X5.22 L.)						1	1			1		1
	5125153	STUD (3/8 -24X4.94 L.)						1	1			1		1
6A	179838	BOLT, 3/8 -16X7/8 (12.9001)	9	9	8	9	9	9	9	9	9	9	9	9
6A	186288	BOLT, 3/8 -16X4 1/2 (12.9001)	1	1	2	1	1			1	1		1	
6A	186315	BOLT, 3/8 -24X4 1/2 (12.9001)	8	8	4	8	8	7	7	8	8	7	8	7
	5138619	WASHER, 3/8 FLAT (4.1512)		1	2		1	1		1	1			
6A	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR	12	AR	AR	AR	AR	AR	AR	AR	AR	AR
	117049	NUT, 3/8 -24 HEX. (12.9120)	AR		5			AR	AR	AR	AR	AR	AR	AR
	186317	BOLT, 3/8 - 24x5 (12.9001)			1									
		1.5060 - GASKET, FLYWHEEL HOUSING SMALL HOLE COVER												
	5104507	GASKET			2									
6A	5122227	GASKET	3	3		3	3	3	3	3	3	3	3	3
6A	5113061	@ GASKET									1			

@ USED WITH 5136765 ADAPTOR AS SHOWN IN 7.4587.

1.6000 CONNECTING ROD AND PISTON

1.6001 - CONNECTING ROD ASSY.

QUANTITIES SHOWN ARE (1) PER CYLINDER.
A ROD ASSY. INCLUDES CAP WHICH IS NOT SOLD SEPARATELY, PLUS ITEMS IN 1.6001, 1.6010, 1.6020 AND 1.6040.
THE CROSSHEAD ROD INCLUDES ONLY ITEMS IN 1.6001.
FOR TYPE 133 USE TYPE 137.
FOR TYPE 161 USE TYPE 143.

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 137	138	143
7B	5144848	ROD ASSY. (CROSSHEAD)	1	1	1
7A,B	5132383	BOLT	2	2	2
7A,B	5117629	NUT	2	2	2

1.6100 - SHELL, CONNECTING ROD BEARING

A SHELL SET CONSISTS OF ONE UPPER AND ONE LOWER BEARING SHELL.

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 137	138	143
7A,B					
7A,B					
	5199946	SHELL SET (STD.)	AR	AR	AR
	5199947	SHELL SET (.002 U.S.)	AR	AR	AR
	5199950	SHELL SET (.010 U.S.)	AR	AR	AR
	5199953	SHELL SET (.020 U.S.)	AR	AR	AR
	5149108	SHELL SET (.030 U.S.)	AR	AR	AR

1.6106 - RING, CROSSHEAD PISTON SEAL

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 137	138	143
7B	5144837	RING SEAL		1	1

1.6110 - PISTON ASSY.

A CROSSHEAD PISTON ASSY. INCLUDES CROWN AND SKIRT IN 1.6110 PLUS ITEMS IN 1.6106, 1.6142 AND 1.6150.
A TRUNK TYPE PISTON INCLUDES BUSHING

1.6000 CONNECTING ROD AND PISTON

FIG.	PART NUMBER	NAME AND DESCRIPTION	1 3 7	TYPES 1, 3 8	 1 4 3
	1.6110 -	PISTON ASSY. (CONT'D)			
		AND RETAINER IN 1.6145 AND 1.6150.			
7B	5199573	PISTON ASSY. (17 1, KEYSTONE, CROSSHEAD) (TURBO)		1	1
7B	5199350	PISTON ASSY. (18.7 1, KEYSTONE, CROSSHEAD)	1		
7B	5147651	CROWN, PISTON (CROSSHEAD)		1	1
7B	5147650	CROWN, PISTON (CROSSHEAD)	1		
7B	5144836	SKIRT, PISTON (CROSSHEAD)	1	1	1
	1.6115 -	RING SET, PISTON			
		CONSISTS OF SUFFICIENT RINGS FOR ONE (1) CYLINDER.			
	5199824	RING SET (KEYSTONE, TURBO)		AR	AR
	5199825	RING SET (KEYSTONE, NON-TURBO)	AR		
	1.6120 -	RING, PISTON COMPRESSION			
	5100797	RING	1		
7A,B	5122321	RING	1	1	1
7A	5148035	RING	1	1	1
7A	5148028	RING, FIRE		1	1
	1.6130 -	RING, PISTON OIL CONTROL			
		AN OIL CONTROL RING CONSISTS OF SCRAPERS AND EXPANDER FOR (1) GROOVE. AN OIL CONTROL RING SET CONSISTS OF SCRAPERS AND EXPANDERS FOR (1) PISTON.			
7A,B	5199827	RING SET	1		
7A,B	5199826	RING SET		1	1
	1.6140 -	PIN, PISTON			
7B	5144744	PIN (CROSSHEAD)	1	1	1
7B	5144846	SPACER	2	2	2
7B	5148373	BOLT, 7/16 -20X2 (12 PT.)	2	2	2
	1.6142 -	BEARING, PISTON PIN			
7B	5144843	BEARING (SLIPPER TYPE)	1	1	1

1.6000 CONNECTING ROD AND PISTON

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 137	138	143
	1.6150 -	RETAINER, PISTON PIN			
	5180250	RETAINER	2	2	2
	1.6185 -	SHIM, CYLINDER LINER			
	1.6180 -	LINER, CYLINDER			
7A,B	5113953	LINER (STANDARD) (OVAL PORT)	1	1	1
7A,B	5197565	LINER (.001 O.S., O.D.)	AR	AR	AR
7A,B	5193732	LINER (.005 O.S., O.D.)	AR	AR	AR
7A,B	5193733	LINER (.010 O.S., O.D.)	AR	AR	AR
7A,B	5193734	LINER (.020 O.S., O.D.)	AR	AR	AR
7A,B	5193735	LINER (.030 O.S., O.D.)	AR	AR	AR
	1.6182 -	CYLINDER KIT			
		A KIT INCLUDES STANDARD SIZE ITEMS IN 1.6110, 1.6115, 1.6140, 1.6142, 1.6150 AND 1.6180, UNLESS OTHERWISE NOTED, FOR (1) CYLINDER.			
	5199822	CYLINDER KIT (KEYSTONE CROSSHEAD)	AR		
	5199956	CYLINDER KIT (KEYSTONE, CROSSHEAD) (.001 O.S., O.D.)	AR		
	5149249	* CYLINDER KIT (KEYSTONE CROSSHEAD TURBO) (N75 INJECTOR AND BELOW)		AR	AR
	5199821	CYLINDER KIT (KEYSTONE, CROSSHEAD, TURBO) (ABOVE N75 INJECTORS) * THRU 8VA-332222. @ EFF. WITH 8VA-322223.		AR	AR
	1.6185 -	SHIM, CYLINDER LINER			
	5199569	SHIM (.002)	AR	AR	AR
	1.6187 -	INSERT, CYLINDER LINER			
	5184484	INSERT (STD.) (STD. AND .005 O.S. LINER)	1	8	16
	5148399	INSERT (STD.) (STD. AND .005 O.S. LINER) (.1810 -.1815 THICK) (RED)	AR	AR	AR
	5148440	INSERT (STD.) (STD. AND .0055 O.S. LINER) (.1780 -.1785 THICK) (BLACK)	AR	AR	AR
	5194073	INSERT (.004 U.S.) (STD. AND .005 LINER)	AR	AR	AR

1.6000 CONNECTING ROD AND PISTON

1.6187 - INSERT, CYLINDER LINER (CONT'D)

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 137	138	143
	5194074	INSERT (.008 U.S.) (STD. AND .005 LINER)	AR	AR	AR
	5193316	INSERT (STD.) (.010 -.030 LINER)	AR	AR	AR
	5194163	INSERT (.005 U.S.) (.010 -.030 LINER)	AR	AR	AR
	5194164	INSERT (.008 U.S.) (.010 -.030 LINER)	AR	AR	AR
	5195871	INSERT (.0015 O.S.)	AR	AR	AR
	5195872	INSERT (.0015 U.S.)	AR	AR	AR

1.7000 CAMSHAFT AND GEAR TRAIN

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	59	79	99	100
		1.7001 - CAMSHAFT												
		A CAMSHAFT ASSY. INCLUDES PLUG IN 1.7C01.												
7C	5117857	CAMSHAFT ASSY. (RIGHT BANK, R.H. ENG.) (STAMPED 5117870) (6V)	1											
7C	5117858	CAMSHAFT ASSY. (LEFT BANK, R.H. ENG.) (STAMPED 5117869) (6V)	1											
7C	5117853	CAMSHAFT ASSY. (RIGHT BANK, R.H. ENG.) (STAMPED 5117872) (8V)		1							1		1	1
7C	5117854	CAMSHAFT ASSY. (LEFT BANK, R.H. ENG.) (STAMPED 5117871) (8V)		1							1		1	1
7C	5117849	CAMSHAFT ASSY. (RIGHT BANK, R.H. ENG.) (STAMPED 5117874) (12V)			1							1	1	
7C	5117850	CAMSHAFT ASSY. (LEFT BANK, R.H. ENG.) (STAMPED 5117873) (12V)			1							1	1	
7D	5146163	* CAMSHAFT ASSY. (RIGHT BANK, L.H. ENG.) (STAMPED 5145919) (6V)				1								
7C	5117860	CAMSHAFT ASSY. (LEFT BANK, L.H. ENG.) (STAMPED 5117875) (6V)				1								
7D	5146074	* CAMSHAFT ASSY. (RIGHT BANK, L.H. ENG.) (STAMPED 5139796) (8V)					1							
7C	5117856	CAMSHAFT ASSY. (LEFT BANK, L.H. ENG.) (STAMPED 5117877) (8V)					1							
7C	5117851	CAMSHAFT ASSY. (RIGHT BANK, L.H. ENG.) (STAMPED 5117880) (12V)						1						
7C	5117852	CAMSHAFT ASSY. (LEFT BANK, L.H. ENG.) (STAMPED 5117879) (12V)						1						
7C	5126018	CAMSHAFT ASSY. (RIGHT BANK, REAR, R.H. ENG.) (LEFT BANK, FRONT, L.H. ENGINE) (STAMPED 5126027) (16V)							1	1				
7C	5126017	CAMSHAFT ASSY. (LEFT BANK, REAR, R.H. ENG.) (RIGHT BANK, FRONT, L. H. ENGINE) (STAMPED 5126026) (16V)							1	1				
7C	5126020	CAMSHAFT ASSY. (RIGHT BANK, FRONT, R.H. ENG.) (LEFT BANK, REAR, L.H. ENGINE) (STAMPED 5126029) (16V)							1	1				
7C	5126019	CAMSHAFT ASSY. (LEFT BANK, FRONT, R.H. ENG.) (RIGHT BANK, REAR, L.H. ENGINE) (STAMPED 5126028) (16V)							1	1				
	5151277	PLUG	4	4	4	4	4	4	8	8	4	4	4	4
	9421745	@ PLUG, 1/2 CUP (12.9330)	1	1	1	1	1	1						

* EFFECTIVE WITH 6VA-56594 AND 8VA-119824 REQUIRES BOLT AND WASHER IN 1.7200 FOR GEAR RETENTION. DOES NOT REQUIRE RETAINER AND ATTACHING BOLTS IN 1.7207.

@ NOT PART OF CAMSHAFT ASSY. USE IN CONJUNCTION WITH 5151277 IN FRONT OF LEFT BANK CAMSHAFT, WITH SUITABLE

1.7000 CAMSHAFT AND GEAR TRAIN

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES											
			38	40	41	42	43	44	52	56	59	79	99	100
		1.7001 - CAMSHAFT (CONT'D)												
		SEALANT, WHEN NECESSARY.												
		1.7010 - BEARING, CAMSHAFT END												
		INCLUDES BUSHING.												
7C	5111422	BEARING, REAR (STD.)	2	2	2	2	2	2	4	4	2	2	2	2
7C	5117984	BEARING, FRONT (STD.)	2	2	2	2	2	2			2	2	2	2
	5103930	BEARING, INNER (STD.)							4	4				
7C	5194858	BEARING, REAR (.010 U.S., I.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5197569	BEARING, FRONT (.010 U.S., I.D.)	AR	AR	AR	AR	AR	AR			AR	AR	AR	AR
7C	5109353	BEARING, INNER (.010 U.S., I.D.)							AR	AR				
7C	5197236	BEARING, REAR (.010 O.D. WITH STANDARD I.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5197237	BEARING, REAR (.010 O.S., O.D. WITH .010 U.S., I.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5197238	BEARING, REAR (.010 O.S., O.D. WITH .020 U.S., I.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5194859	BEARING, REAR (.020 U.S., I.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5197613	BEARING, FRONT (.020 U.S., I.D.)	AR	AR	AR	AR	AR	AR			AR	AR	AR	AR
7C	5109354	BEARING, INNER (.020 U.S., I.D.)							AR	AR				
7C	186622	BOLT, 3/8 -16X1 1/4 (REAR)(12.9001)	6	6	6	6	6	6	12	12	6	6	6	6
7C	9414268	BOLT, 3/8 -16X1 1/2 (FRONT) (12 PT. HD.) (12.9005)	6	6	6	6	6	6	6	6	6	6	6	6
	103321	LOCKWASHER, 3/8 (12.9200)	6	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
		1.7012 - GASKET, CAMSHAFT FRONT END BEARING												
7C	5117243	GASKET		1	1	1	1	1			1	1	1	1
		1.7015 - BUSHING, CAMSHAFT END												
	5111423	BUSHING (GROOVED)	6	8	8	8	8	8	8	8	8	8	8	8
	5194825	BUSHING (.020 U.S.) (UNFINISHED)		AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
	5197110	@ BUSHING (INNER)(.020 U.S.) (UNFINISHED)							8	8				
		* TIMING GEAR END ON 16V.												
		@ MAY BE FINISHED TO STANDARD OR .010 UNDERSIZE.												
		1.7030 - WASHER, CAMSHAFT END BEARING THRUST												
7C	5111424	WASHER (STD.)	4	4	4	4	4	4	8	8	4	4	4	4
7C	5194826	WASHER, (.005 O.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5194827	WASHER (.010 O.S.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR

1.7000 CAMSHAFT AND GEAR TRAIN

	PART		TYPES											
FIG.	NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	59	79	99	100
	1.7040	BEARING, CAMSHAFT INTERMEDIATE												
		A BEARING SET CONSISTS OF ONE (1) UPPER AND ONE (1) LOWER BEARING.												
7C	5196026	BEARING SET (STD.)	4	6	10	4	6	10	12	12	6	10	10	6
7C	5196029	BEARING SET (.010 O.S. ON O.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5196027	BEARING SET (.010 U.S. ON I.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
7C	5196028	BEARING SET (.020 U.S. ON I.D.)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
	1.7050	RING, CAMSHAFT INTERMEDIATE BEARING LOCK												
7C	5115572	RING	8	12	20	8	12	20	24	24	12	20	20	12
7C	5117649	BOLT	4	6	10	4	6	10	12	12	6	10	10	6
	1.7060	SEAL, CAMSHAFT OIL												
7C	5116476	SEAL, OIL (FRONT, LEFT BANK)	1	1	1	1	1	1			1	1	1	1
	1.7130	PULLEY, FRONT BALANCE												
7C	5117777	PULLEY	1			1								
7C	5138717	* PULLEY (5.38 GROOVE DIA.)		1			1				1			
7C	5122259	PULLEY			1			1				1		
7C	5132665	PULLEY (6.29 DIA., 2 GROOVES) (7.1505)											1	1
7C	5145905	* PULLEY (6.29 GROOVE DIA.)												1
7C	127559	KEY, 1/4 X3/4 WOODRUFF (12.9350)	2	1	1	1	1	1					1	1
7C	127559	KEY, 1/4 X3/4 WOODRUFF (12.9350)									2	2		
7C	5177769	LOCKWASHER, 1 1/8 INT. TOOTH (1.7140)	2	1	1	1	1	1			2	2	1	1
7C	5150087	NUT, 1 1/8 -18 HEX.	2	1	1	1	1	1			2	2	1	1
		* EFFECTIVE WITH 8VA-115016, MUST BE USED WITH CROSSHEAD PISTON.												
	1.7140	WEIGHT, FRONT BALANCE												
7C	5121873	@ WEIGHT		1			1				1			1
7C	5145732	& WEIGHT		1			1				1			1
7C	5121874	% WEIGHT			1			1					1	
7C	9409035	BOLT, 3/8 -24X1 HEX. HD. LOCK (12.9001)		2	2		2	2			2		2	2
		@ THRU 8VA-566. NOT SERVICED FOR SERVICE USE (1) 5145732, (1) 5126904, (1) 5146254 AND (2) 9409035.												

1.7000 CAMSHAFT AND GEAR TRAIN

1.7140 - WEIGHT, FRONT BALANCE (CONT'D)

& EFF. WITH 8VA-115016 MUST BE USED WITH CROSSHEAD PISTON.
% THRU 12VA-457. NOT SERVICED FOR SERVICE USE (1) 5126839 AND (1) 5146254.

1.7190 - WEIGHT, REAR BALANCE

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	55	70	99	100
	5199558	* WEIGHT (2 HOLES) (DRILLED)		2			2				2			2
7C	5121971	@ WEIGHT (2 HOLES) (TAPPED)		2			2				2			2
7C	5145612	# WEIGHT (2 HOLES) (DRILLED)		2			2				2			2
	5108876	# SCREW, 3/8 -24X1 1/2 FLAT HD.		4			4				4			4
	9409037	+ BOLT, 3/8 -24X1 1/4 LOCK (12.9001)		4			4				4			4
	5145092	BOLT, 3/8 -24X1.20 SELF LOCK (12.4037)		8			8				8			8
	5145091	* BOLT, 3/8 -24X1.38 (W/.56 THK. ACC. DRIVE DISC) (12.4037)		4			4				4			4
	9413980	# NUT, 3/8 -24 HEX. (1.6001)		4			4				4			4

* USE FOR IN-FRAME CHANGE TO CROSSHEAD PISTON ON UNITS PRIOR TO 8VA-115016. NEW WATER PUMP DRIVE GEAR WEIGHTS AND FRONT BALANCE PULLEY MUST ALSO BE INCLUDED.
@ THRU 8VA-1202 NOT SERVICED REPLACE WITH 5145612 WEIGHT AND INCLUDE (4) 5108876 SCREWS AND (4) 9413980 NUTS TO ASSURE INTERCHANGEABILITY.
# USE FOR SERVICE EFF. WITH 8VA-1203. FIRST PRODUCTION USAGE EFF. WITH 8VA-115016 MUST BE USED WITH CROSSHEAD PISTON.
+ THRU 8VA-1202.

1.7200 - GEAR, CAMSHAFT

DOES NOT INCLUDE WEIGHTS.

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	55	70	99	100
7C	5121815	GEAR (R.H. HELIX) (RIGHT BANK) (REAR)	1	1		1	1				1			1
7C	5121816	GEAR (L.H. HELIX) (LEFT BANK) (REAR)	1	1		1	1				1			1
7C	5126904	GEAR (RIGHT BANK) (FRONT) (66 TEETH)	1	1		1	1				1			1
7C	5117134	GEAR (R.H. HELIX) (RIGHT BANK) (REAR)			1			1				1	1	
7C	5117133	GEAR (L.H. HELIX) (LEFT BANK) (REAR)			1			1				1	1	

1.7000 CAMSHAFT AND GEAR TRAIN

1.7200 - GEAR, CAMSHAFT

(CONT'D)

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	59	79	99	103
7C	5126839	* GEAR (RIGHT BANK) (FRONT) (66 TEETH)			1			1				1	1	
7C	5126014	GEAR (R.H. HELIX)							2	2				
7C	5126015	GEAR (L.H. HELIX)							2	2				
7C	127559	KEY, 1/4 X3/4 WOODRUFF (WATER PUMP DRIVE GEAR TO SHAFT) (12.9350)	2	1	1	1	1	1			1	1	1	1
7C	5153914	KEY, 1/4 X1 WOODRUFF (1.7140)	2	2	2	2	2	2	4	4	2	2	2	2
7D	9412015	@ BOLT, 9/16 -18X2 1/2 (12.9001)				1	1							
7D	5141367	@ WASHER, 19/32 I.D. X 1.68 O.D.				1	1							
7C	5177769	# LOCKWASHER, 1 1/8 (1.7140)		3							3	3	3	3
7C	5177765	@ LOCKWASHER, 1 1/8 (1.7140)			2	2	2	2						
7C	5150087	NUT, 1 1/8 HEX. (1.7140)	2	3					4	4	3		3	3
7C	5150087	@ NUT, 1 1/8 HEX. (1.7140)			2	2	2	2				2		

@ EFFECTIVE WITH 6VA-56594, 8VA-119824 IN TYPES 42 AND 43.

1.7202 - SPACER, CAMSHAFT GEAR

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	59	79	99	103
7C	5116485	SPACER (.64 L.) (FRONT)	2	2	2	2	2	2			2	2	2	2

1.7207 - RETAINER, CAMSHAFT GEAR NUT

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	59	79	99	103
	5172734	RETAINER	1	1		1	1				1			1
7C	5172734	RETAINER	2	2	2	2	2	2	2	2	2	2	2	2
	186627	BOLT, 3/8 -24X1 (12.9001)	8	4		4	4				4			4
7C	186627	BOLT, 3/8 -24X1 (12.9001)	8	8	8	8	8	8	16	16	8	8	8	8
7C	103321	LOCKWASHER, 3/8 (12.9200)	8	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR

1.7220 - GEAR ASSY., IDLER

INCLUDES ITEMS IN 1.7222 THRU 1.7250 AND FLYWHEEL HOUSING ATTACHING PARTS.

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	40	41	42	43	44	52	56	59	79	99	103
8B	5199384	GEAR ASSY. (L.H. HELIX)	1	1	1				2		1	1	1	1
8B	5199327	GEAR ASSY. (R.H. HELIX)				1	1	1		1				

1.7000 CAMSHAFT AND GEAR TRAIN

FIG.	PART NUMBER	NAME AND DESCRIPTION	38	TYPES 40	41	42	43	44	52	56	55	79	99	100
		1.7222 - GEAR, IDLER												
8B	5113817	GEAR (L.H. HELIX) (R.H. ENG. ROTATION)	1	1	1				2		1	1	1	1
8B	5113818	GEAR (R.H. HELIX) (L.H. ENG. ROTATION)				1	1	1		2				
		1.7225 - BEARING, IDLER GEAR												
		INCLUDES INNER AND CUTER BEARING SPACER ANC CAP.												
8B	7451948	BEARING ASSY.	1	1	1	1	1	1	2	2	1	1	1	1
		1.7227 - RETAINER, IDLER GEAR BEARING												
8B	5176958	RETAINER	1	1	1	1	1	1	2	2	1	1	1	1
8B	5103534	BOLT, 5/16 -24X1/2 (VIBRA TITE)	6	6	6	6	6	6	12	12	6	6	6	6
		1.7250 - HUB ASSY., IDLER GEAR												
		INCLUDES DOWEL IN 1.7250.												
8B	5117104	* HUB ASSY.		1	1	1	1	1	2	2	1	1	1	1
8B	5130135	HUB ASSY.	1	1	1	1	1	1	2	2	1	1	1	1
	5151444	DOWEL	2	1	1	1	1	1	2	2	1	1	1	1
8B	186689	@ BOLT, 1/2 -13X2 (12.9001)		1	1	1	1	1	2	2		1	1	1
8B	454992	BOLT, 1/2 -13X2 1/2 (12.9001)	2	1	1	1	1	1	2	2	1	1	1	1
	5167714	WASHER	2	1	1	1	1	1	2	2		1	1	1
	5131755	WASHER									1			
		* THRU 6VA-18723, 8VA-8985, 12VA-277C, 16VA-219, 24A-009. NOT SERVICED, REPLACE WITH 5130135 HUB AND 454992 BOLT. @ WITH 5117104 HUB ASSY. OR 5117194 SPACER ASSY.												
		1.7260 - SPACER ASSY., IDLER GEAR HOLE												
		INCLUDES DOWEL IN 1.7260.												
8B	5131719	SPACER ASSY.	1	1	1	1	1	1	2	2		1	1	1
	5151444	DOWEL (1.7250)		1	1	1	1	1	2	2	1	1	1	1
8B	186689	@ BOLT, 1/2 -13X2 (12.9001)		1	1	1	1	1	2	2		1	1	1
8B	5131378	BOLT, 1/2 -13X2 (12.9001)									1			
8B	454992	BOLT, 1/2 -13X2 1/2 (12.9001)		1	1	1	1	1	2	2		1	1	1
	5167714	WASHER (1.7250)		1	1	1	1	1	2	2	1	1	1	1

1.7000A BALANCE WEIGHT COVER

1.7470 - COVER, BALANCE WEIGHT

A COVER ASSEMBLY INCLUDES DOWEL PINS IN 1.7470.

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 18	19	20	24	27	28	44
9A,B	5141661	COVER ASSY.	1	1	1				1
9A,B	5109739	COVER ASSY.				1			
9A,B	5132087	# COVER ASSY.						1	
9B	141236	PIN, 3/8 X1/2 DOWEL (12.9290)	3	3	3	3		3	3
	444660	PLUG, 3/8 HEX. SKT. HD. (12.9550)				1			
	181370	BOLT, 3/8 - 24 x 1 1/4 (12.9001)				1			1
9A,B	179848	BOLT, 3/8 -16X2 1/4 (12.9001)	2	2	2	2	2	2	2
9A,B	181371	BOLT, 3/8 -24X1 3/8 (12.9001)	6	6	6	6	6	6	5
9A,B	179888	BOLT, 1/2 -13X1 7/8 (12.9001)	1	1	1	1	1	1	1
9A,B	442734	BOLT, 1/2 -13X4 (12.9001)				1			
9A,B	271564	BOLT, 5/8 -11X2 1/2 (12.9001)	2	2	2	2	2	2	1
	103341	WASHER, 3/8 FLAT (12.9190)	8	8	8	8	8	8	8
	103343	WASHER, 1/2 FLAT (12.9190)	1	1	1	1	1	1	2
	103345	WASHER, 5/8 FLAT (12.9190)	2	2	2	2	2	2	
9B	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR	AR	AR	AR	AR	8
9B	103323	LOCKWASHER, 1/2 (12.9200)	AR	AR	AR	AR	AR	AR	1
	117049	NUT, 3/8 -24 HEX. (12.9120)	4	4	4	4			4
	117049	NUT, 3/8 -24 HEX. (12.9120)					5	5	

# NOT SERVICED FOR SERVICE USE 5141661 AND INCLUDE 1-5122680 COVER, 1-5123 GASKET AND 2-9419648 SCREW, AND 1-5145024 FAN SUPPORT.

1.7480 - GASKET, BALANCE WEIGHT COVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 18	19	20	24	27	28	44
9B	5117905	* GASKET	1	1	1				
9B	5123638	GASKET	1	1	1		1	1	1
9B	5109663	GASKET				1			

* THRU 6VA-639, 8VA-325, 12VA-210.

1.7490 - COVER, ACCESSORY DRIVE HOLE

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 18	19	20	24	27	28	44
	5122680	COVER (4.1290)		1	1				
	9419648	SCREW, 5/16 -18X3/4 , SELF-TAP, HEX. HD. (12.9066)		2	2				

1.7500 - GASKET, ACCESSORY DRIVE HOLE COVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 18	19	20	24	27	28	44
	5123123	GASKET (7.4455)		1					

1.8000 VALVE OPERATING MECHANISM

FIG.	PART NUMBER	NAME AND DESCRIPTION	24	25	26	37	38	40	41	52	67	86	97
		1.8060 - ARM ASSY., EXHAUST VALVE ROCKER FOR TYPE 78 USE TYPE 26. FOR TYPE 96 USE TYPE 97. INCLUDES ITEMS IN 1.8100, 1.8120, 1.8130, 1.8140 AND 1.8150.											
11A	5148472	ARM ASSY. (LEFT)	6	1	1		1		1	1	1		1
11A	5148475	ARM ASSY. (RIGHT)	6	1	1		1		1	1	1		1
11A	5150304	ARM ASSY. (LEFT)				1		1				1	
11A	5150305	ARM ASSY. (RIGHT)				1		1				1	
		1.8080 - ARM ASSY., INJECTOR ROCKER INCLUDES ITEMS IN 1.8110 THROUGH 1.8150.											
11A	5179954	ARM ASSY.	6	1	1	1	1	1	1	1	1	1	1
		1.8100 - BUSHING, EXHAUST VALVE ROCKER ARM-LARGE											
11A	5122445	BUSHING	12	2	2	2	2	2	2	2	2	2	2
		1.8110 - BUSHING, INJECTOR ROCKER ARM-LARGE											
11A	5150318	BUSHING	16	1	1	1	1	1	1	1	1	1	1
		1.8120 - BUSHING, INJECTOR AND EXHAUST VALVE ROCKER ARM-SMALL											
11A	5150311	BUSHING	18	3	3	3	3	3	3	3	3	3	3
		1.8130 - CLEVIS, INJECTOR AND EXHAUST VALVE ROCKER ARM											
11A	5150312	CLEVIS	18	3	3	3	3	3	3	3	3	3	3
		1.8140 - BUSHING, INJECTOR AND EXHAUST VALVE ROCKER ARM CLEVIS											
11A	5123700	BUSHING	18	3	3	3	3	3	3	3	3	3	3

1.8000 VALVE OPERATING MECHANISM

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 24	25	26	37	38	40	41	52	67	86	97
	1.8150 -	PIN, INJECTOR AND EXHAUST VALVE ROCKER ARM CLEVIS											
11A	5150314	PIN (PUSH ROD END)	18	3	3	3	3	3	3	3	3	3	3
	1.8160 -	SHAFT ASSY., ROCKER											
11A	5150322	SHAFT ASSY. (INCLUDES PLUG)	6	1	1	1	1	1	1	1	1	1	1
11A	5151272	PLUG	6	1	1	1	1	1	1	1	1	1	1
	1.8170 -	BRACKET, ROCKER SHAFT											
11A	5150324	BRACKET	12	AR	24	12	16	24	32	AR	16	24	32
11A	5150325	BOLT	12	AR	24	12	16	24	32	AR	16	24	32
	1.8180 -	ROD, PUSH											
11A	5128640	ROD	18	AR	36	18	24	36	48	AR	24	36	48
11A	5151601	LOCKNUT	18	AR	36	18	24	36	48	AR	24	36	48
	1.8190 -	SPRING, PUSH ROD											
11A	5166858	SPRING	18	AR	36	18	24	36	48		24	36	48
11A	5108918	SPRING								AR			
	1.8200 -	SEAT, PUSH ROD SPRING-UPPER											
11A	5150302	SEAT	18	AR	36	18	24	36	48		24	36	48
11A	5108919	SEAT								AR			
	1.8210 -	SEAT, PUSH ROD SPRING-LOWER											
11A	5123250	SEAT	18	AR	36	18	24	36	48	AR	24	36	48

1.8000 VALVE OPERATING MECHANISM

FIG.	PART NUMBER	NAME AND DESCRIPTION	24	25	26	37	38	40	41	52	67	86	97
	1.8210 -	SEAT, PUSH ROD SPRING-LOWER (CONT'D)											
	1.8250 -	RETAINER, PUSH ROD											
11A	5150303	RETAINER (SNAP RING)	18	AR	36	18	24	36	48	AR	24	36	48
	1.8260 -	FOLLOWER ASSY., CAM											
11A	5115087	FOLLOWER ASSY. (INCLUDES ROLLER SET)	18	AR	36	18	24	36	48	AR	24	36	48
	1.8265 -	ROLLER SET, CAM FOLLOWER INCLUDES ROLLER WITH BUSHING AND PIN.											
	5195220	ROLLER SET (STANDARD)	18	AR	36	18	24	36	48	AR	24	36	48
	1.8300 -	GUIDE, CAM FOLLOWER											
11A	5150298	GUIDE	6	AR	12	6	8	12	16	AR	8	12	16
11A	443603	BOLT, 1/4 X3/4 (12.9001)	12	AR	24	12	16	24	32	AR	16	24	32
11A	103319	LOCKWASHER, 1/4 (12.9200)	12	AR	24	12	16	24	32	AR	16	24	32
	1.8310 -	VALVE, EXHAUST											
11B	5195167	VALVE (INCLUDES LOCKS)	24	AR	48		32				32		
11C	5193666	* VALVE (INCLUDES LOCKS)				12		24				24	
11B	5194968	* VALVE (INCLUDES LOCKS) (TURBO) . . .							64	32			
11B	5199938	* VALVE (INCLUDES LOCKS)											64
		* FOR TYPES 25 AND 52 USE A QUANTITY OF 8 FOR AN EIGHT, 12											

1.8310 - VALVE, EXHAUST (CONT'D)

FOR A TWELVE AND 16 FOR A SIXTEEN.

1.8320 - GUIDE, EXHAUST VALVE

INSTALLER (PKG.) INCLUDES 100 PIECES.

FIG.	PART NUMBER	NAME AND DESCRIPTION	24	25	26	37	38	40	41	52	67	86	97
	5192717	GUIDE (.016 O.S.-O.D.)				AR		AR					
11B	5129919	GUIDE (4 VALVE CYLINDER HEAD)	12	32	48		32		64	64	32		64
11C	5120930	GUIDE (2 VALVE CYLINDER HEAD)				12		24				24	
	5100699	* SEAL (2 VALVE CYLINDER HEAD)				12							
	5129920	* SEAL (4 VALVE CYLINDER HEAD)					32						
	5199914	INSTALLER, EXHAUST VALVE SEAL (2 VALVE)				AR		AR				AR	
	5199913	INSTALLER, EXHAUST VALVE SEAL (4 VALVE)	AR	AR	AR		AR		AR	AR	AR		AR

* NOT PART OF CYLINDER HEAD ASSY.

1.8330 - INSERT, EXHAUST VALVE

FIG.	PART NUMBER	NAME AND DESCRIPTION	24	25	26	37	38	40	41	52	67	86	97
11C	5131096	INSERT (2 VALVE CYLINDER HEAD)				12		24				24	
11C	5198230	INSERT (.010 O.S.) (2 VALVE CYLINDER HEAD)				AR		AR				AR	
11B	5101101	INSERT (STANDARD) (4 VALVE CYLINDER HEAD)	12	32	48		32		64	64	32		64
11B	5197167	INSERT (.010 O.S.) (4 VALVE CYLINDER HEAD)	AR	AR	AR		AR		AR	AR	AR		AR

1.8340 - SPRING, EXHAUST VALVE

FIG.	PART NUMBER	NAME AND DESCRIPTION	24	25	26	37	38	40	41	52	67	86	97
11B	5111339	@ SPRING (VALVE AND GUIDE)		48	72								
11B	5117561	# SPRING		32	48		32		64	64	32		64
	5147347	SPRING (SINGLE OR DOUBLE YELLOW STRIPE)	24	32	48		32		64	64	32		64
11C	5150289	SPRING				12		24				24	

@ THRU 6VA-5307, 8VA-1057, 12VA-521.
# EFFECTIVE WITH 6VA-5308, 8VA-1058, 12VA-522.

1.8343 - BRIDGE, EXHAUST VALVE

FIG.	PART NUMBER	NAME AND DESCRIPTION	24	25	26	37	38	40	41	52	67	86	97
11B	5117565	BRIDGE	12	16	24		16		32	32	16		32
11B	5129101	SCREW, ADJUSTING	12	16	24		16		32	32	16		32
11B	5151601	LOCKNUT (1.8180)	12	16	24		16		32	32	16		32

1.8000 VALVE OPERATING MECHANISM

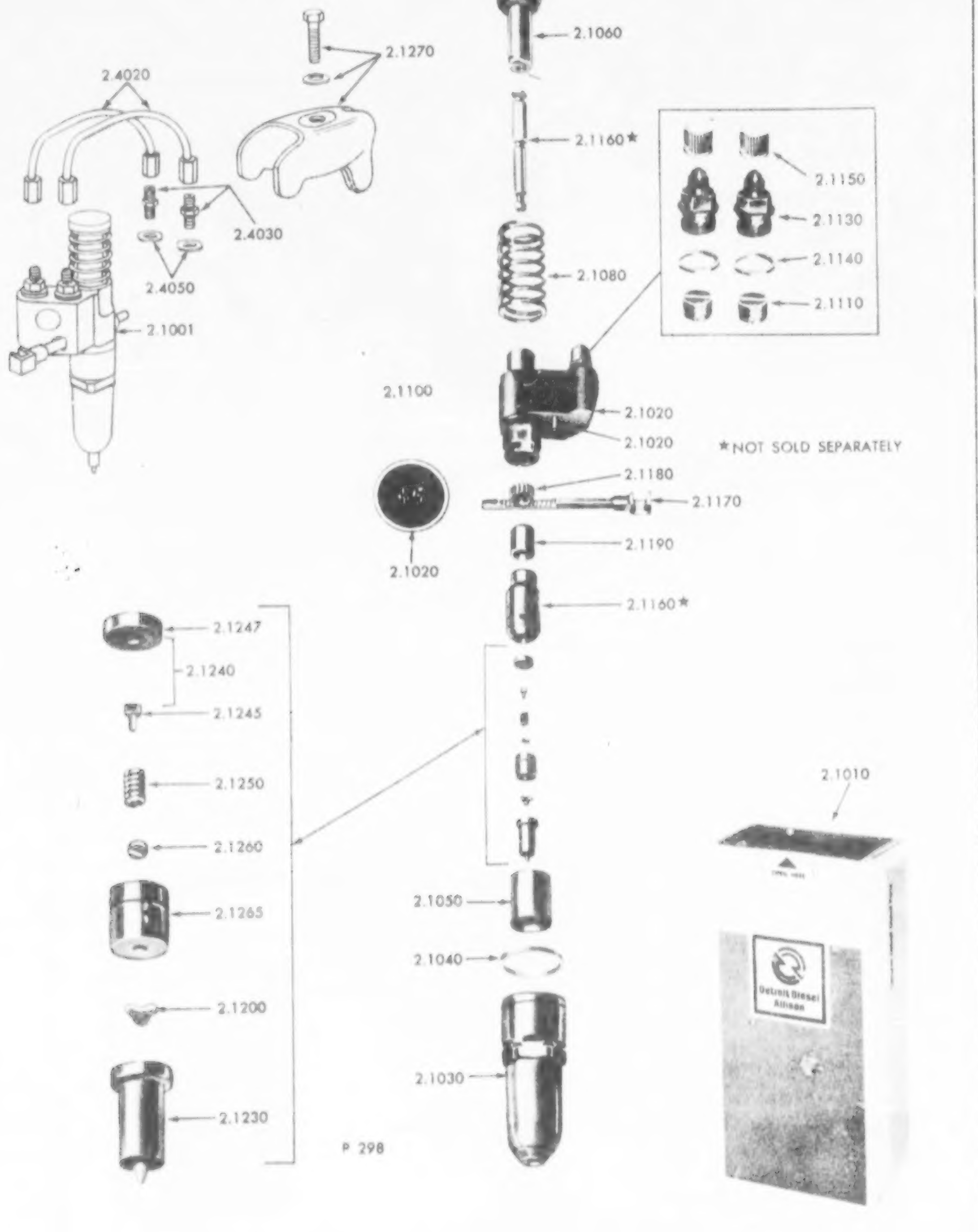
FIG.	PART NUMBER	NAME AND DESCRIPTION	24	25	26	37	38	40	41	52	67	86	97
		1.8345 - GUIDE, EXHAUST VALVE BRIDGE											
11B	5196843	@ GUIDE (THREADED TYPE)		16	24								
11B	5117564	GUIDE (PRESSED IN TYPE)	12	16	24		16		32	32	16		32
		@ THRU 6VA-5307, 8VA-1057, 12VA-521.											
		1.8350 - CAP, EXHAUST VALVE SPRING											
11B	5111338	@ CAP		32	48								
11B	5117563	CAP	24	32	48		32		64	64	32		64
11C	5150291	CAP				12		24				24	
		@ THRU 6VA-5307, 8VA-1057, 12VA-521.											
		1.8360 - SEAT, EXHAUST VALVE SPRING											
11B	5196148	& * SEAT		AR	48								
11B	5117562	SEAT	24	AR	48		32		64	AR	32		64
11B	5150292	SEAT				12		24				24	
		& THRU 6VA-5307, 8VA-1057, 12VA-521.											
		1.8370 - LOCK, EXHAUST VALVE SPRING											
11B	5111337	LOCK (HALVES)	48	AR	96		64		128	AR	64		128
11C	838029	LOCK (HALVES)				24		48				48	

1.8000A ROCKER COVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	136	137	138	139	143	146	150	151	161	166	168	180
		1.8450 - COVER ASSY., ROCKER												
12B	5115520	COVER ASSY. (8V-16V)			1							2		
12B	5132550	COVER ASSY. (ITEM D) (8V-16V)			1		1					2		
12B	5115521	COVER ASSY., PLAIN (12V)						1		1			1	
12B	5178381	COVER ASSY., PLAIN (6V)									1			1
12A,B	5158971	* COVER ASSY., (ITEM F) (6V)									1			
12B	5132551	@ COVER ASSY. (ITEM D) (12V)					1		1					
12B	5198961	@ * COVER ASSY. (ITEMS D & F) (12V)								1				
12B	5145691	* COVER ASSY. (ITEM F) (8V)	1											
	5145720	COVER ASSY. (PLAIN- JACOBS BRAKE-8V)	1											
12B	5138814	COVER ASSY., PLAIN (6V)		2										
12A	5140155	COVER ASSY. (ITEM L) (8V)				1								
12B	5148878	COVER ASSY. (ITEMS D & F) (8V)				1			1					
12B	5158963	* COVER ASSY. (ITEMS D & F) (12V)					1							
12B	5157133	COVER ASSY. (ITEM C) (12V)						1						
12A,B	5148873	* COVER ASSY. (ITEM F) (12V)											1	
		* USE WITH ITEMS IN 4.5000A TYPE 46. @ USE WITH ITEMS IN 4.8000A, TYPE 358.												
		1.8455 - GASKET, ROCKER COVER												
12A	5143406	GASKET (NEOPRENE) (8V-16V)	2		2	2			2				4	
12A	5143407	GASKET (NEOPRENE) (12V)					2	2		2	2			
12A	5143405	GASKET (NEOPRENE) (6V)		2								2		2
		1.8460 - BOLT, ROCKER COVER												
12A	5157194	BOLT			4	4	8	8	4	8	4	4	8	4
12A	5175156	BOLT	4	4										
12A	455532	PIN, 1/8 X1 ROLL (12.9275)	4	4	4	4	8	8	4	8	4	4	8	4
12A	5150333	WASHER	4	4	4	4	8	8	4	8	4	4	8	4
		1.8475 - STUD, ROCKER COVER												
	5157192	STUD	4	4							4	4	8	
	5148504	STUD			4	4	8	8	4	8				4

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover
2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls
3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler
4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System
5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter
6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections
7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid
8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines
9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission—Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car
10.0000	SHEET METAL
10.1000A	Engine Hood
11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base
12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits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2.1160*
2.1080
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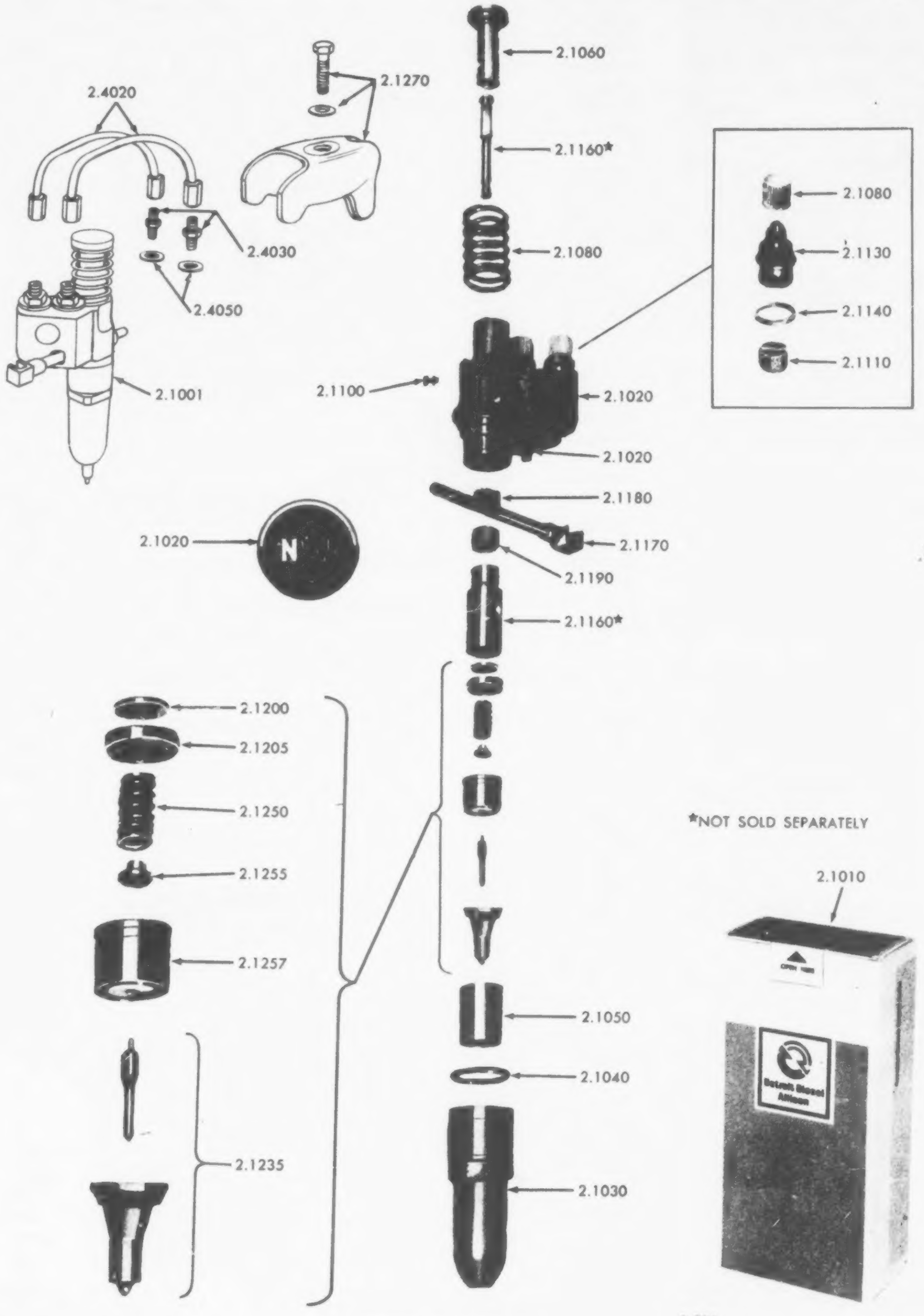
2.1140
2.1110
2.1100
2.1020
2.1020
2.1020
*NOT SOLD SEPARATELY
2.1180
2.1170
2.1190
2.1160*
2.1247
2.1240
2.1245
2.1250
2.1260
2.1265
2.1200
2.1230
2.1050
2.1040
2.1030
2.1010
Detroit Diesel Allison
P 298

FUEL INJECTOR

Fig. 1A of 2.0000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2.1100
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2.1001
2.1020
2.1180
2.1020
N
2.1170
2.1190
2.1160*
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2.1205
2.1250
*NOT SOLD SEPARATELY
2.1255
2.1010
OPEN HERE
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Detroit Diesel Allison
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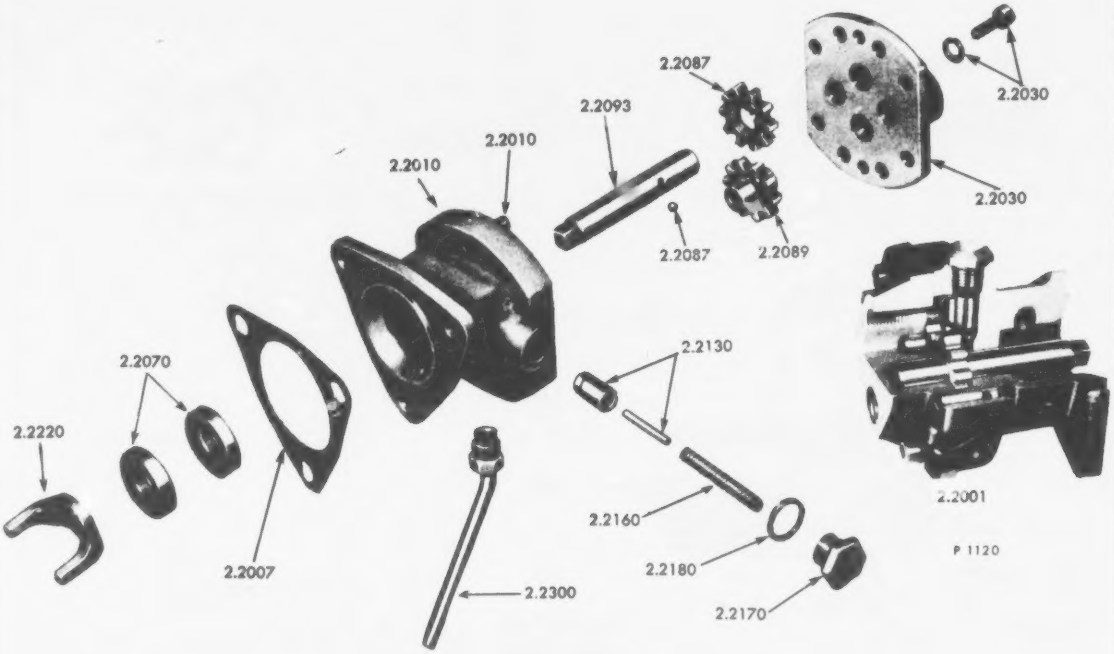
2.1235
2.1030
P 299

FUEL INJECTOR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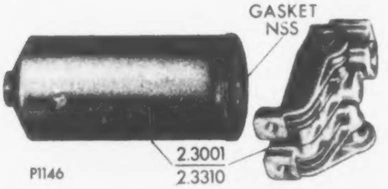
2.2093
2.2010
2.2010
2.2030
2.2087
2.2089
2.2130
2.2070
2.2220
2.2001
2.2160
P 1120
2.2180
2.2007
2.2300
2.2170

FIG. 2A - FUEL PUMP


GASKET NSS
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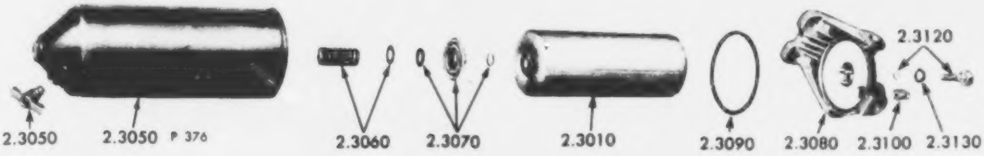
2.3310
P1146

FIG. 2B - FUEL STRAINER, FUEL FILTER (Spin-On)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2.3050
P 376
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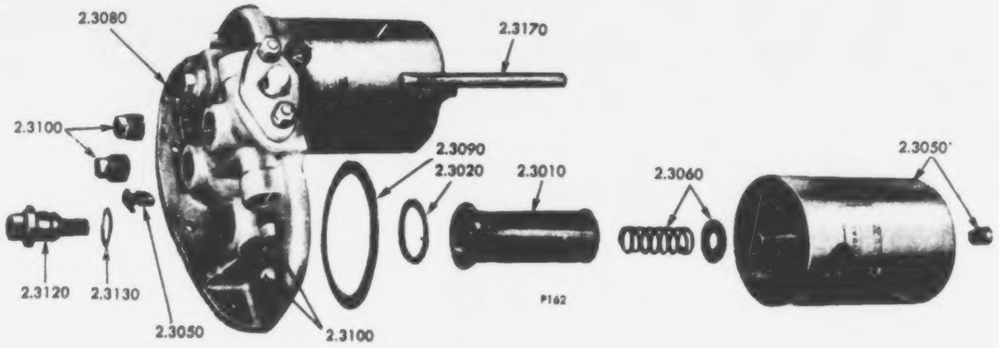
2.3010
2.3090
2.3080
2.3100
2.3130

FIG. 3A FUEL STRAINER (Sock Type Element)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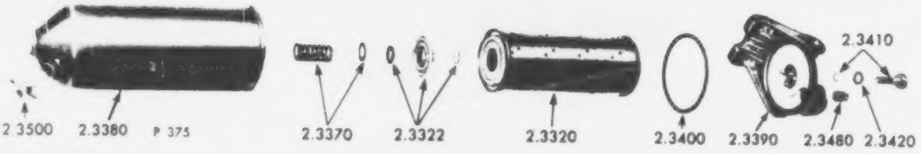
2.3130
P162
2.3050
2.3100

FIG. 3B FUEL STRAINER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2.3500
2.3380
P 375
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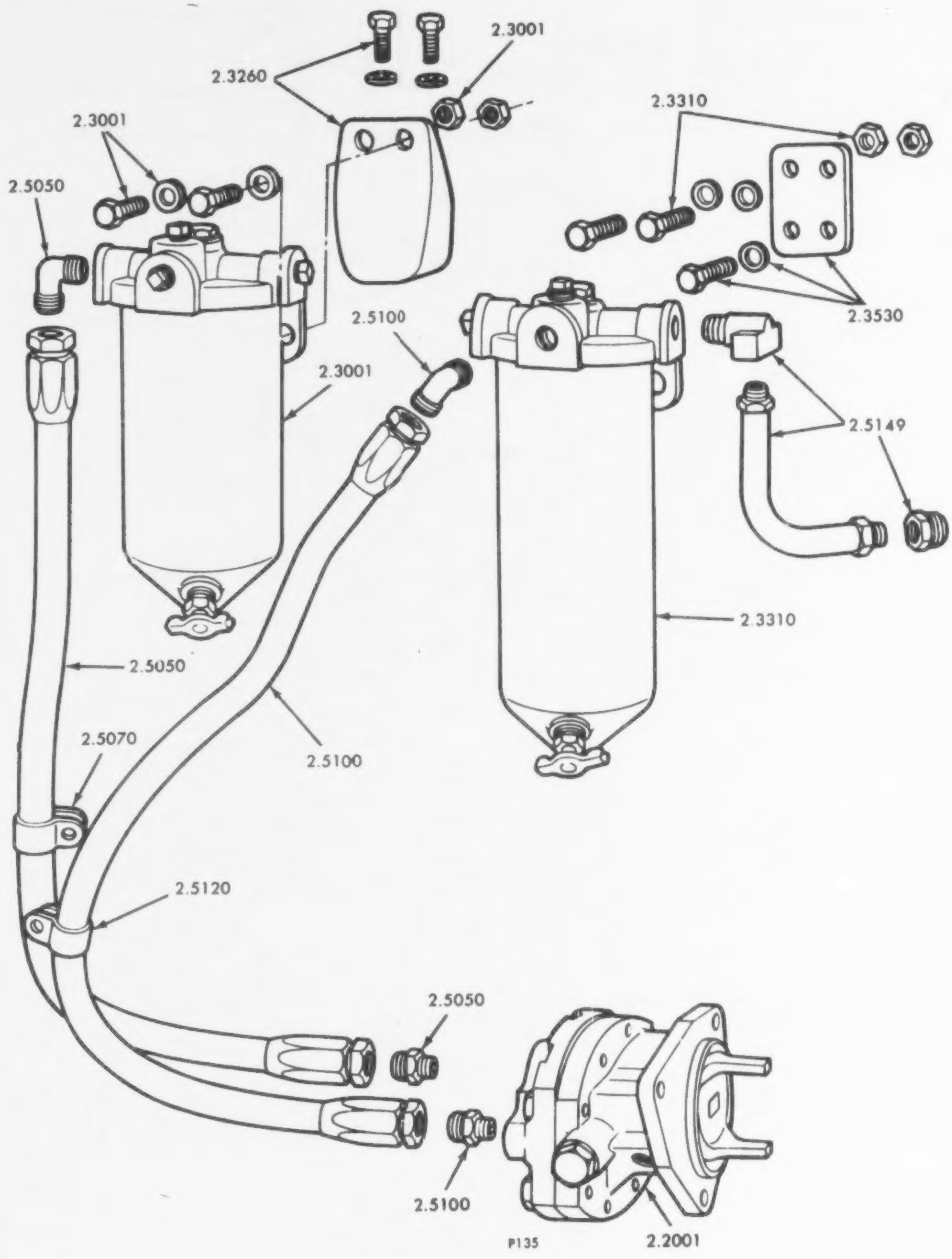
2.3322
2.3320
2.3400
2.3390
2.3480
2.3420

FIG. 3C FUEL FILTER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2.3001
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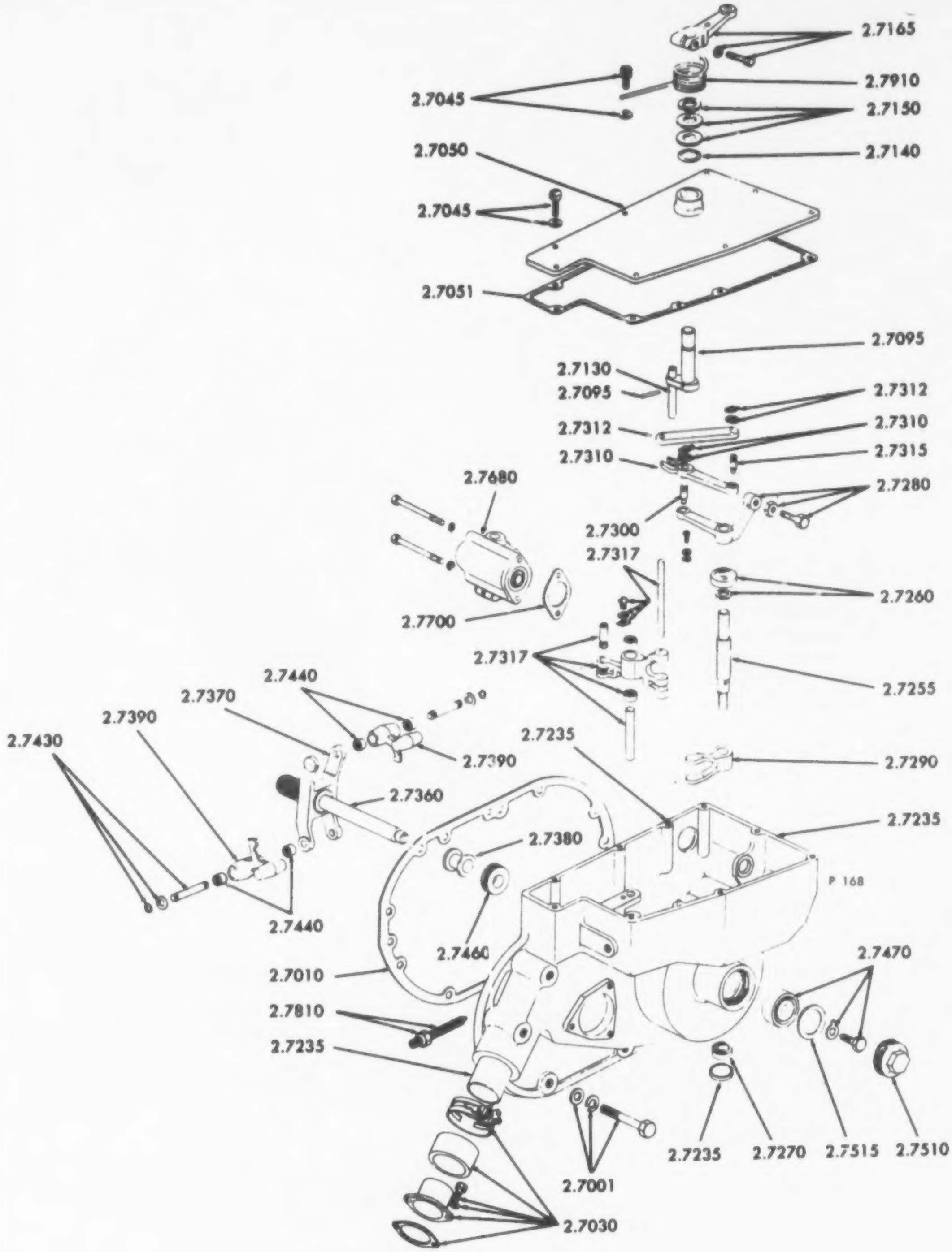
2.3310
2.5050
2.5070
2.5100
2.5120
2.5050
2.5100
P135
2.2001

FIG. 4A TYPICAL FUEL SYSTEM

Fig. 4A of 2.0000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2.7310
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2.7440
2.7255
2.7370
2.7390
2.7430
2.7235
2.7390
2.7290
2.7360
2.7235
2.7380
P 168
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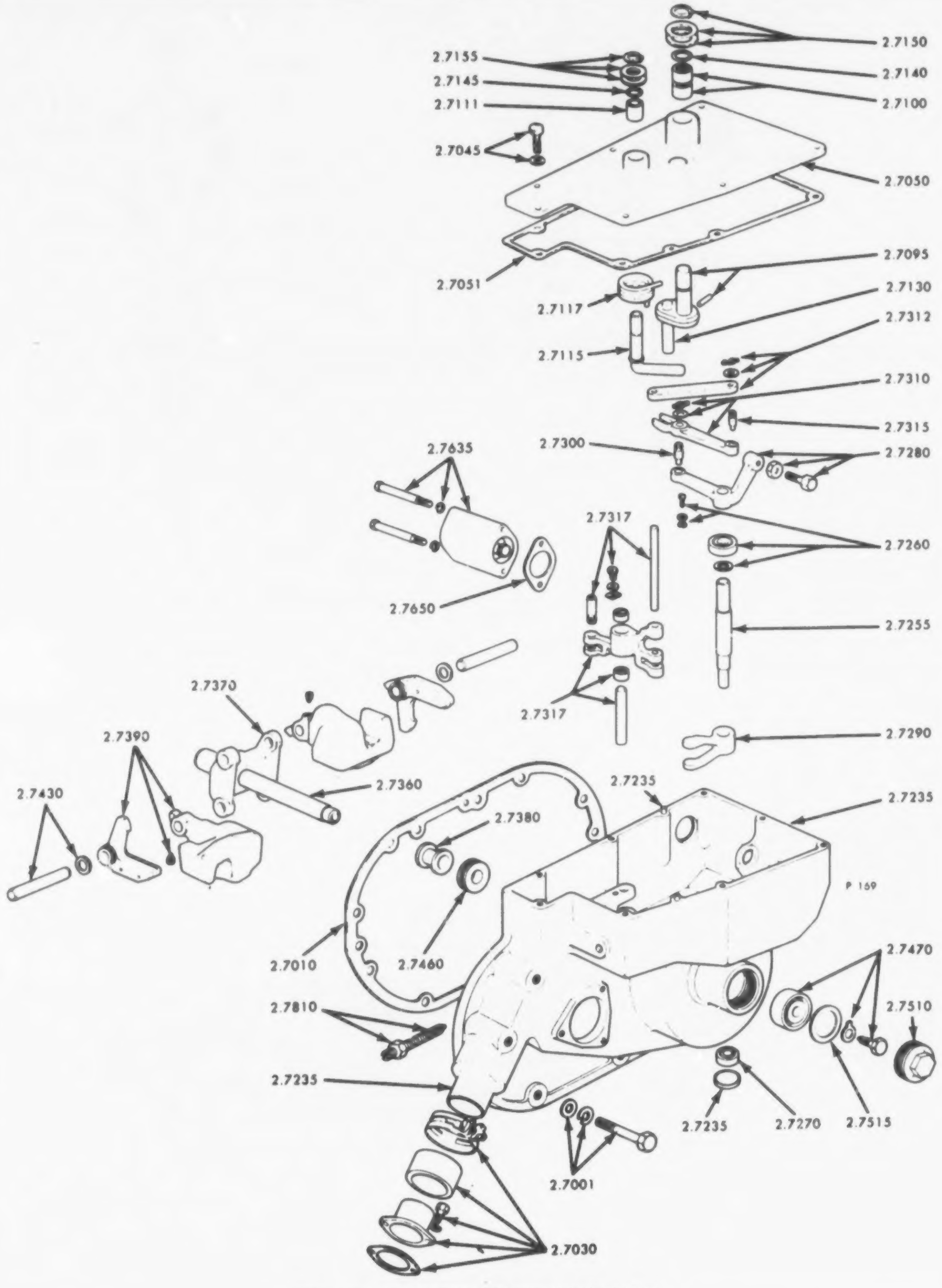
2.7460
2.7010
2.7810
2.7235
2.7235
2.7270
2.7515
2.7510
2.7001
2.7030

FIG. 5A VARIABLE SPEED GOVERNOR

Fig. 5A of 2.0000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2.7235
2.7380
P 169
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2.7460
2.7470
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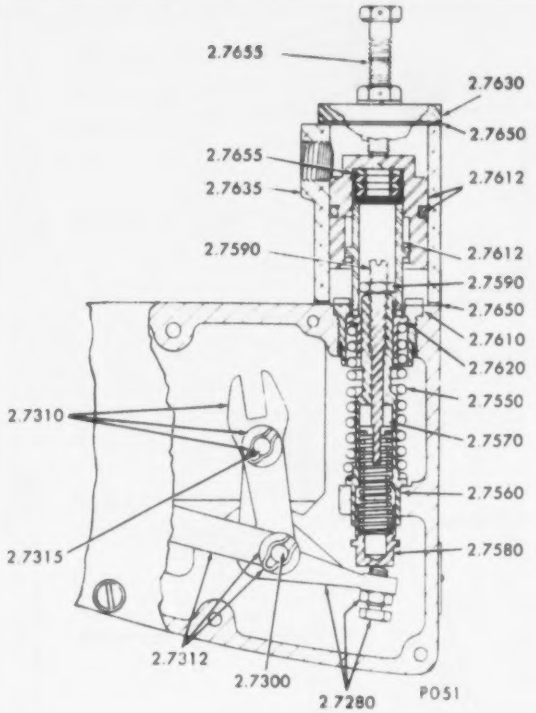
2.7235
2.7270
2.7515
2.7001
2.7030

FIG. 5B LIMITING SPEED GOVERNOR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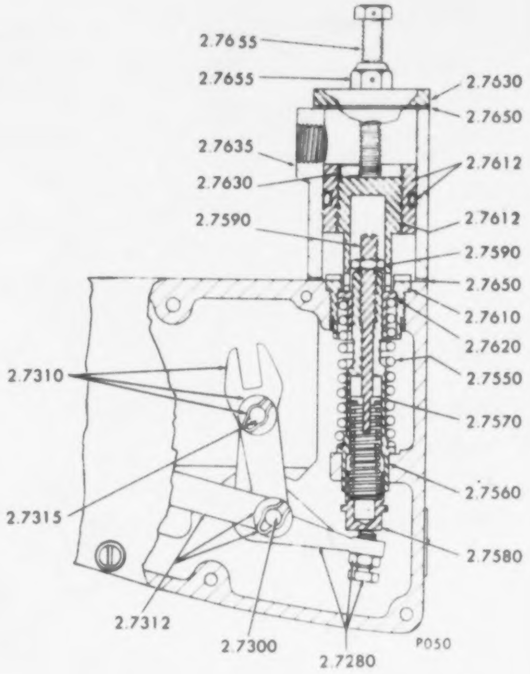
2.7550
2.7310
2.7570
2.7560
2.7315
2.7580
2.7312
2.7300
2.7280
P051

FIG. 5C EARLY TYPE DUAL RANGE GOVERNOR SPEED CONTROL MECHANISM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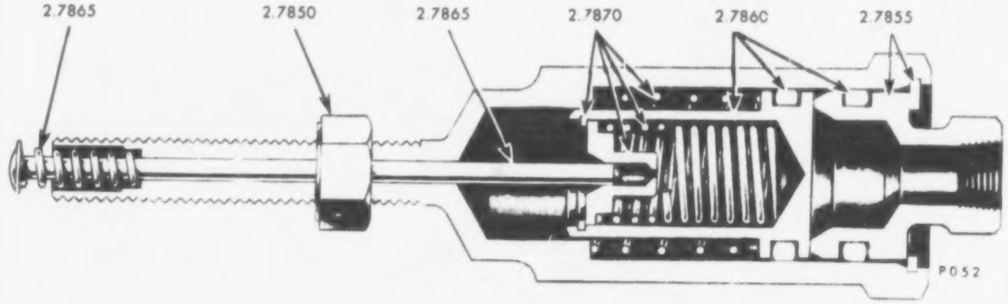
2.7310
2.7550
2.7570
2.7315
2.7560
2.7580
2.7312
2.7300
2.7280
P050

FIG. 5D REVISED DUAL RANGE GOVERNOR SPEED CONTROL MECHANISM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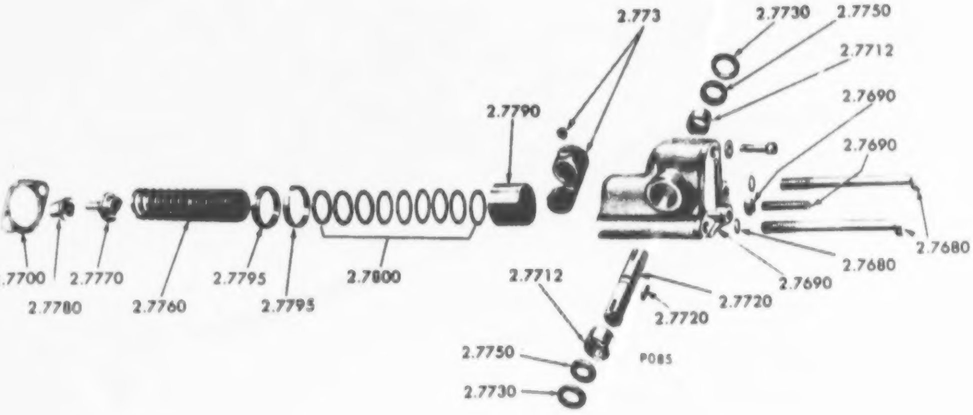
2.7860
2.7855
P052

FIG. 5E FAST IDLE AIR CYLINDER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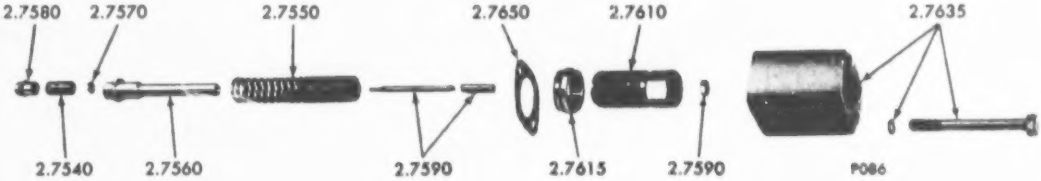
2.7712
2.7680
2.7690
2.7780
2.7760
2.7795
2.7720
2.7720
2.7750
P085
2.7730

FIG. 5F VARIABLE SPEED GOVERNOR SPRING AND HOUSING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2.7650
2.7610
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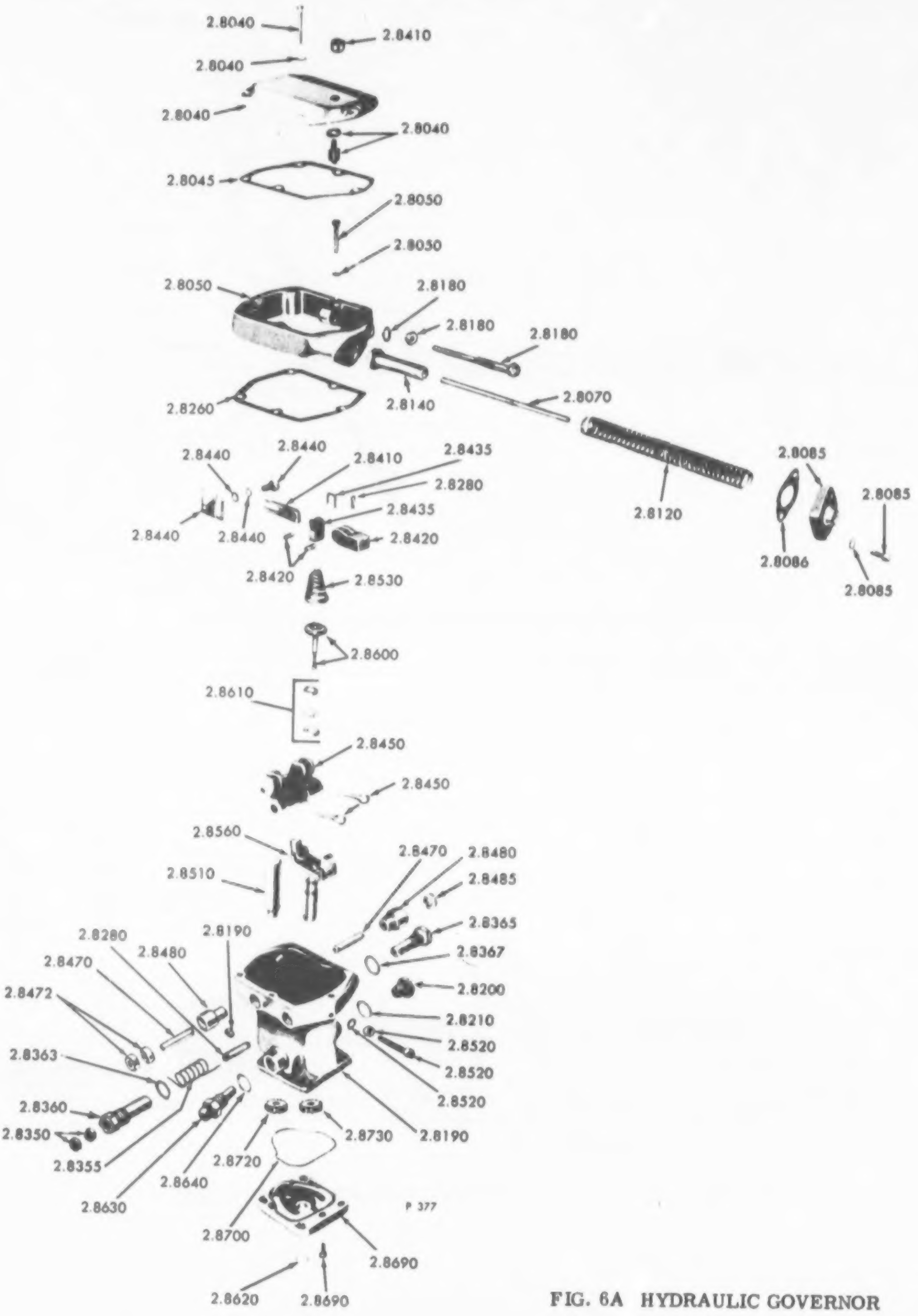
2.7560
2.7590
2.7615
2.7590
P086

FIG. 5G LIMITING SPEED GOVERNOR SPRING AND HOUSING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2.8180
2.8070
2.8260
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2.8440
2.8410
2.8435
2.8280
2.8435
2.8420
2.8440
2.8440
2.8420
2.8530
2.8120
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2.8085
2.8086
2.8085
2.8600
2.8610
2.8450
2.8450
2.8560
2.8510
2.8470
2.8480
2.8485
2.8365
2.8367
2.8200
2.8210
2.8520
2.8520
2.8520
2.8280
2.8190
2.8470
2.8480
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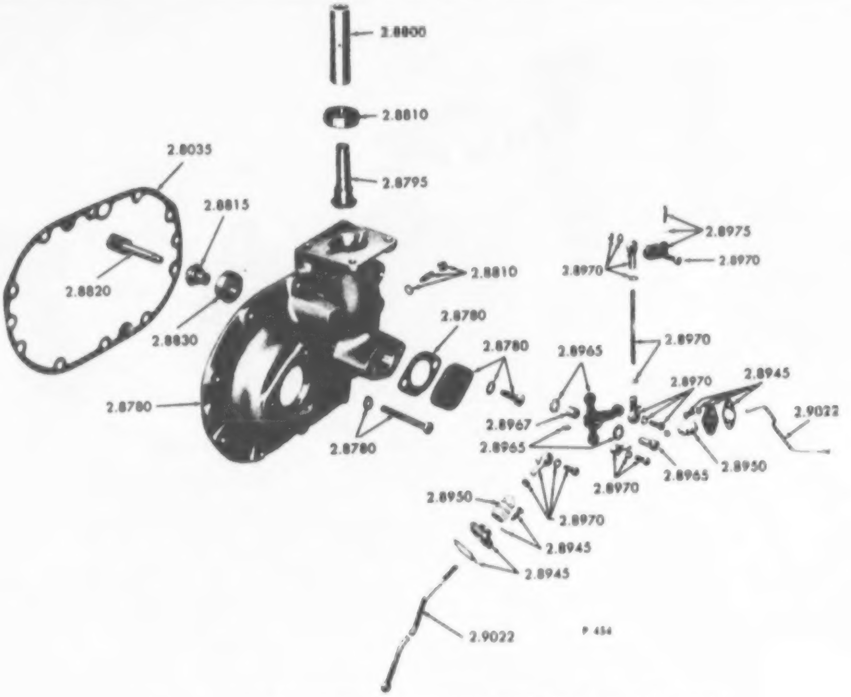
2.8363
2.8360
2.8350
2.8355
2.8630
2.8640
2.8720
2.8730
2.8190
2.8700
2.8690
2.8620
2.8690
P 377

FIG. 6A HYDRAULIC GOVERNOR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2.8970
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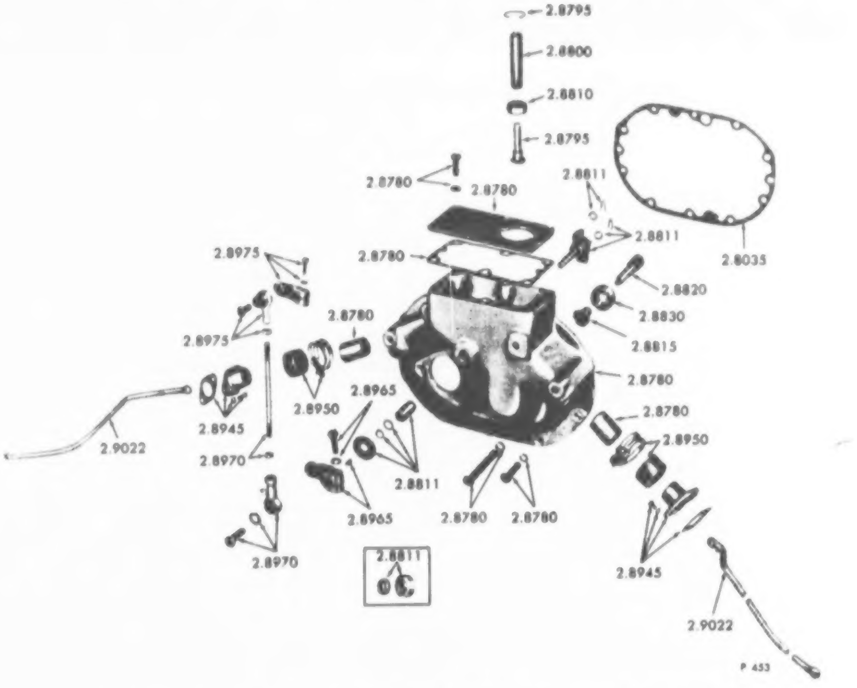
2.8967
2.8965
2.8780
2.8965
2.8950
2.8970
2.8950
2.8970
2.8945
2.8945
2.9022
P 454

FIG. 6B HYDRAULIC GOVERNOR DRIVE (open linkage)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6C
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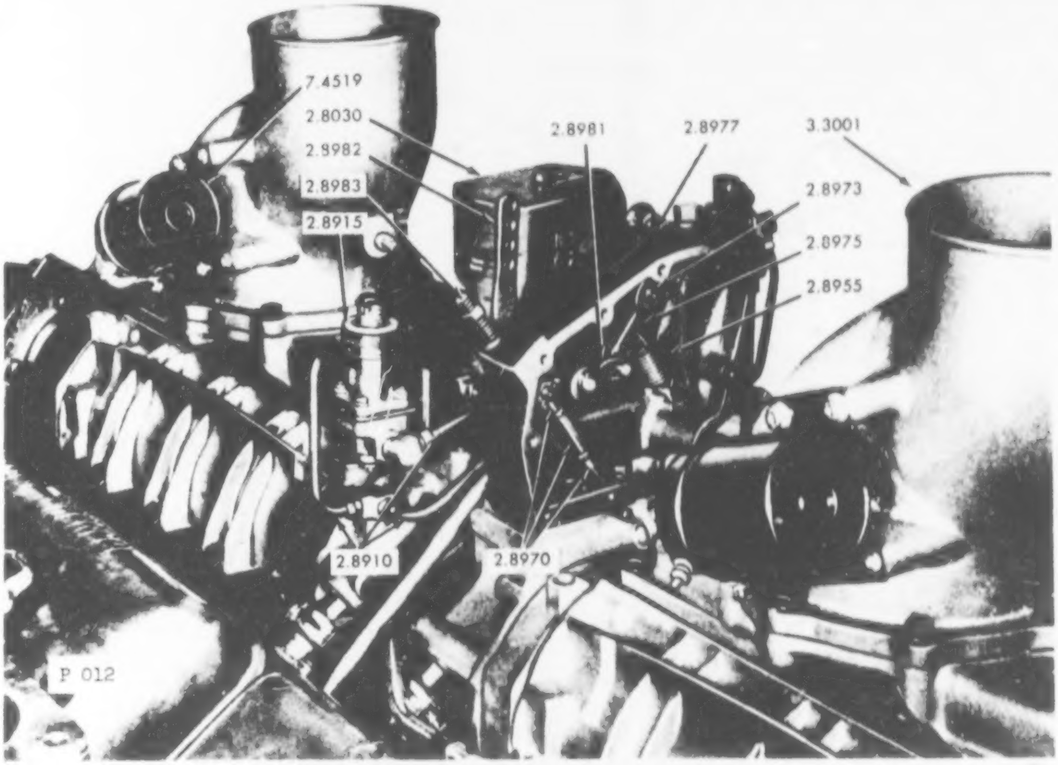
2.9022
P 453

FIG. 6C HYDRAULIC GOVERNOR DRIVE (enclosed linkage)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2.8977
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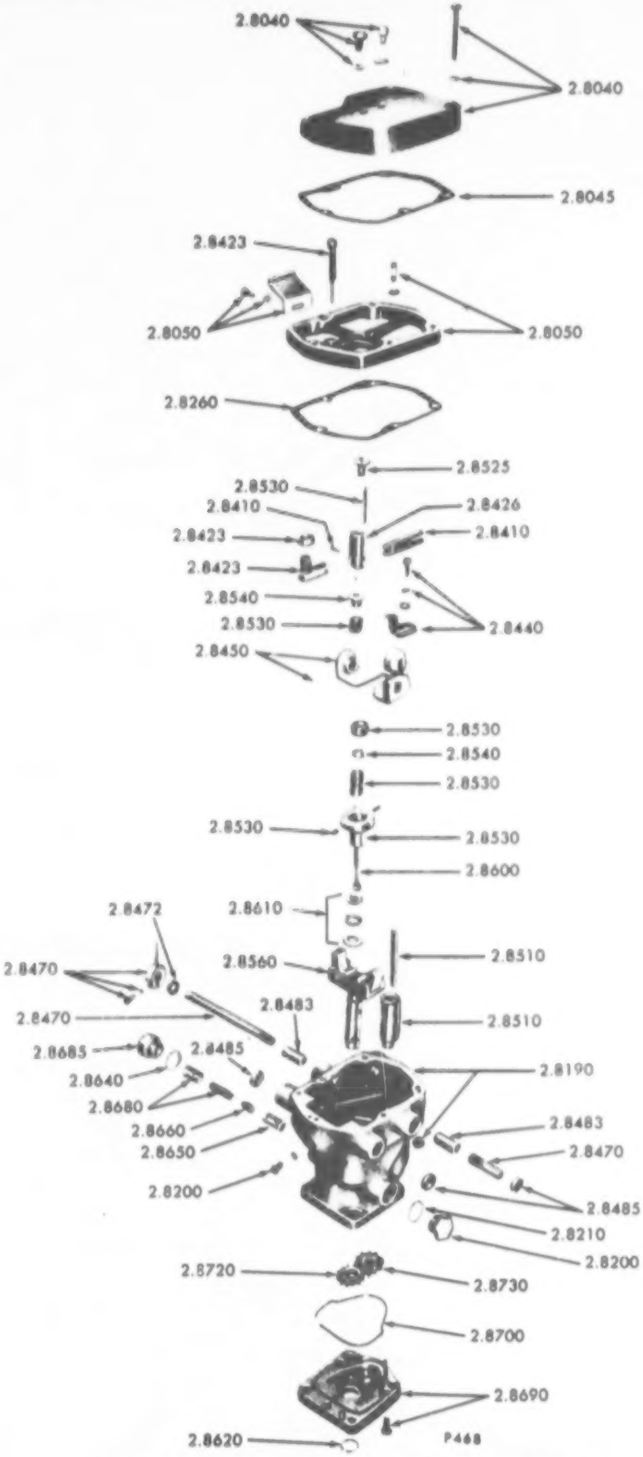
2.8910
2.8970
P 012

HYDRAULIC LIMITING SPEED GOVERNOR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2.8600
2.8472
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2.8470
2.8200
2.8485
2.8210
2.8200
2.8720
2.8730
2.8700
2.8690
2.8620
P468

FIG. 6E HYDRAULIC LIMITING SPEED GOVERNOR

NOTE: Movement of the speed control lever is to take-up the clearance in the governor linkage. The injector rack clevis-to-body clearance can be increased by turning the starting aid screw farther in against the gap adjusting screw, or reduced by backing it out.

IMPORTANT: The starting aid screw will be ineffective if the speed control lever is advanced toward wide open throttle during start-up.

2. On early turbocharged engines, adjust the internal starting aid screw as follows:

a. With the engine *stopped*, place the governor stop lever in the *run* position and the speed control lever in the *idle* position.

b. Hold the gap adjusting screw, to keep it from turning, and adjust the starting aid screw to obtain the required setting between the shoulder on the injector rack clevis and the injector body (Fig. 6). The setting is measured at the No. 3R injector rack clevis.

c. Check the injector rack clevis-to-body clearance after performing the following:

1. Position the stop lever in the *run* position.
2. Move the speed control lever from the *idle* position to the *maximum* speed position.
3. Return the speed control lever to the *idle* position.

NOTE: Movement of the governor speed control lever is to take-up clearances in the governor linkage. The clevis-to-body clearance can be increased by backing out the starting aid screw or reduced by turning it farther into the gap adjusting screw.

d. Start the engine and re-check the running gap (.0015") and, if necessary, reset it and re-position the injector racks. Then stop the engine.

e. Use a new gasket and replace the governor cover and lever assembly. Tighten the screws.

f. Use new gaskets and replace the valve rocker covers.

Adjust Maximum No-Load Engine Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the option plate, the maximum no-load speed may be set as follows:

ENGINES WITH DUAL-RANGE LIMITING SPEED MECHANICAL GOVERNOR (Fig. 7)

After positioning the injector rack control levers, set the maximum engine speeds.

IMPORTANT: Be sure the buffer screw projects 5/8" from the lock nut to prevent interference while adjusting the maximum no-load speeds.

With the spring housing assembly mounted on the governor, the piston and sleeve assembled with four .100" shims and ten .010" shims and the low maximum speed screw extending from the spring housing approximately 1-1/4", proceed as follows:

CAUTION: Do not apply air or oil pressure to the governor until performing Step 1f.

1. Set the high maximum no-load speed.

a. Start the engine and position the engine speed control lever in the maximum speed position.

b. Turn the low maximum speed adjustment screw in until the high maximum speed desired is obtained.

c. Stop the engine and remove the spring housing assembly.

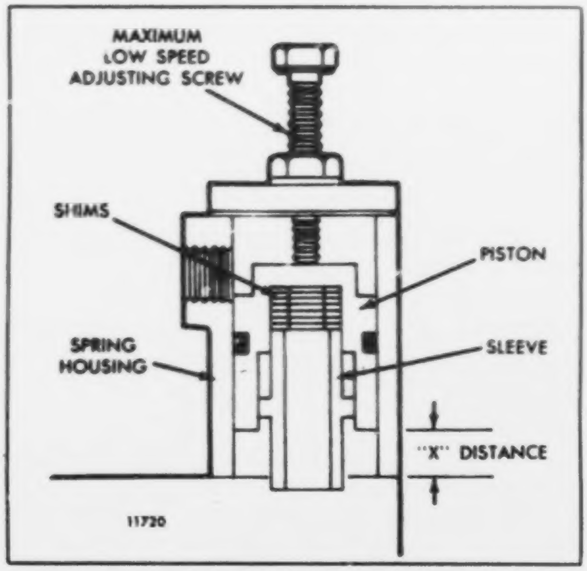


Fig. 7 - Dual-Range Governor (Top View)

best copy available

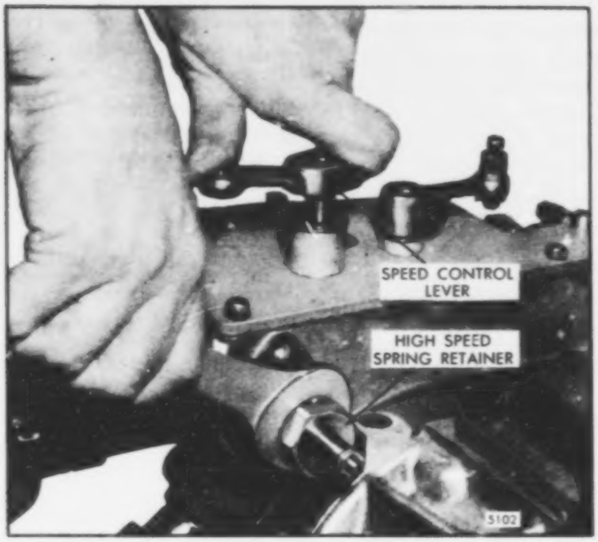


Fig. 8 – Adjusting Maximum No-Load Speed

CAUTION: Do not permit the seal ring on the piston to slide past the air inlet port, since the seal ring will be damaged.

d. Note the distance ("X" distance, Fig. 7) the piston is from the bottom of the spring housing when it is against the low maximum speed screw, then remove the sleeve from the piston.

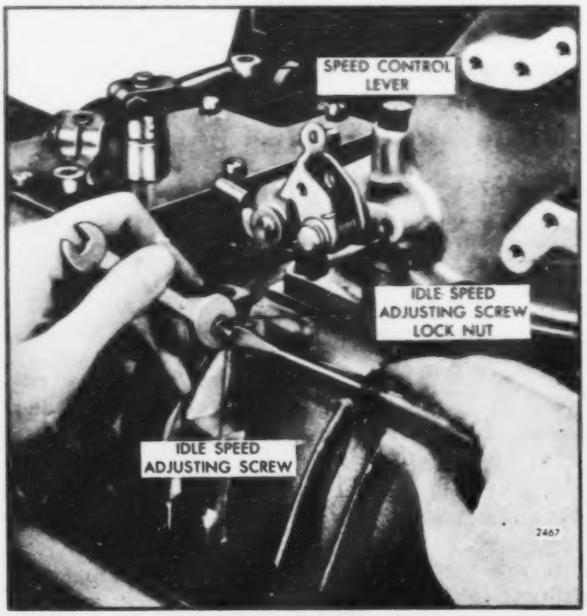

SPEED CONTROL LEVER
IDLE SPEED ADJUSTING SCREW LOCK NUT
IDLE SPEED ADJUSTING SCREW
2467

Fig. 9 – Adjusting Engine Idle Speed

NOTE: When checking this distance, the piston should be held tight against the adjustment screw of the cover that is held in position, with its gasket, against the end of the spring housing.

e. Remove the quantity of shims, from the shims within the piston, equal to the distance noted in Step d.

f. Start the engine and position the engine speed control lever in the maximum speed position and apply air pressure to the governor and note the engine speed.

g. Remove the air pressure from the governor and stop the engine, then install or remove shims as required to obtain the correct high maximum no-load speed. Removing shims will decrease the engine speed and adding shims will increase the engine speed.

NOTE: Each .010" shim removed or added will decrease or increase the engine speed approximately 10 rpm.

2. Set the low maximum no-load engine speed.

a. Adjust the low maximum speed adjusting screw, with the engine speed control lever held in the maximum speed position, until the desired low maximum speed is obtained. Turn the screw in to increase or out to decrease the engine speed.

b. Recheck the engine speed and readjust if necessary.

3. Check both the high maximum and low maximum engine speeds. Make any adjustment that is necessary as outlined in Steps 1 and 2.

ENGINES WITH STANDARD LIMITING SPEED MECHANICAL GOVERNOR (Fig. 8)

After positioning the injector rack control levers, set the maximum no-load engine speed as follows:

NOTE: Be sure the buffer screw projects 5/8" from the lock nut to prevent interference while adjusting the maximum no-load speed.

1. Loosen the spring retainer lock nut (Fig. 8) and back off the high-speed spring retainer approximately five turns.

2. With the engine running at operating temperature and no-load on the engine, place the speed control

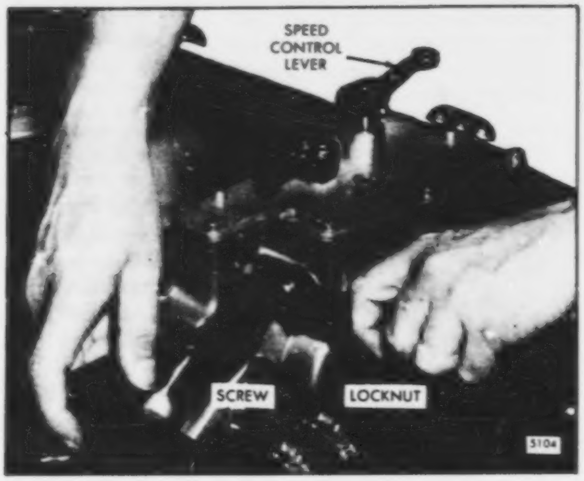


Fig. 10 - Adjusting Buffer Screw

lever in the maximum speed position. Turn the high-speed spring retainer until the engine is operating at the recommended no-load speed.

3. Hold the high-speed spring retainer and tighten the lock nut.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. With the engine running, at normal operating temperature and with the buffer screw backed out to avoid contact with the differential lever, turn the idle speed adjusting screw until the engine is operating at approximately 15 rpm below the recommended idle speed (Fig. 9). The recommended idle speed is 400-450 rpm, but may vary with special engine applications.

> **IMPORTANT:** It may be necessary to use the buffer screw to eliminate engine roll. Back out the buffer screw, after the idle speed is established, to the previous setting (5/8").

2. Hold the idle screw and tighten the lock nut.

3. Install the high-speed spring retainer cover and tighten the two bolts.

Adjust Buffer Screw

With the idle speed properly set, adjust the buffer screw as follows:

1. With the engine running at normal operating temperature, turn the buffer screw (Fig. 10) in so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

> **NOTE:** Do not increase the engine idle speed more than 15 rpm with the buffer screw.

2. Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the buffer screw until the increase is less than 25 rpm.

3. Hold the buffer screw and tighten the lock nut.

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

16V-71 ENGINE

The governor (Fig. 1) on the 16V engine is mounted on and driven from the front end of the rear blower.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and injector rack control levers.

> **NOTE:** Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, reconnect and adjust the supplementary governing device.

If the engine or governor has been overhauled, or the injector control linkage has been disturbed, the control link levers in the governor housing and auxiliary control link housing must be aligned before proceeding with the engine tune-up. Refer to Fig. 2 and position the control link levers as follows:

1. Disconnect the linkage to the governor speed control lever and stop lever.

2. Remove the covers from the governor housing and auxiliary control link housing.

3. Disconnect the adjustable link from the lever in the auxiliary control link housing.

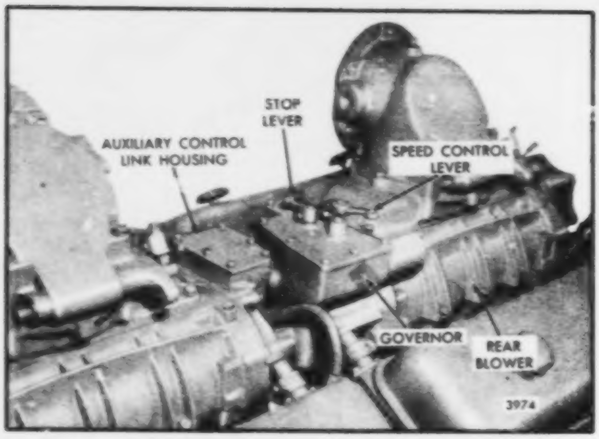

STOP LEVER
AUXILIARY CONTROL LINK HOUSING
SPEED CONTROL LEVER
GOVERNOR
REAR BLOWER
3974

Fig. 1 - Governor Mounting

4. Remove the connecting pin from the auxiliary governor control link lever.

5. Install gage J 21779 so it extends through the lever and fuel rod and into the gage hole in the bottom of the housing. With the gage in place, the auxiliary control link lever will be in the mid-travel position.

6. Remove the connecting pin from the control link lever in the governor housing and install gage J 21780. Install the gage so the pin extends through the connecting link, control lever and fuel rod and the governor housing dowel pin extends into the small hole in the gage. Then install a governor cover bolt as shown in Fig. 2 to lock the gage in place. With gage J 21780 in place, the governor control link lever will be in the mid-travel position and parallel to the auxiliary control link lever.

7. Adjust the length of the adjustable connecting link to retain the lever positions obtained in Steps 5 and 6 and install the link.

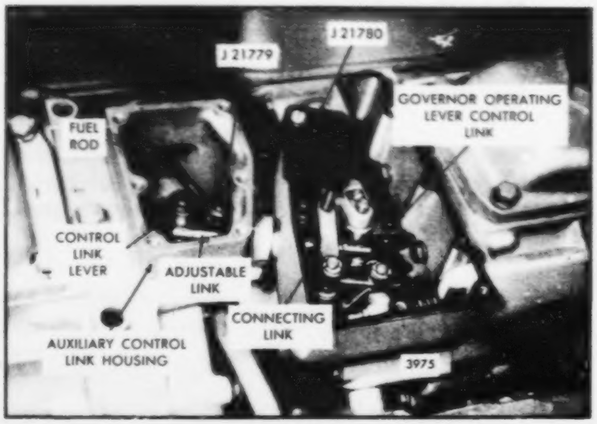

J 21780
J 21779
GOVERNOR OPERATING LEVER CONTROL LINK
FUEL ROD
CONTROL LINK LEVER
ADJUSTABLE LINK
CONNECTING LINK
AUXILIARY CONTROL LINK HOUSING
3975

Fig. 2 - Control Link Levers in Position

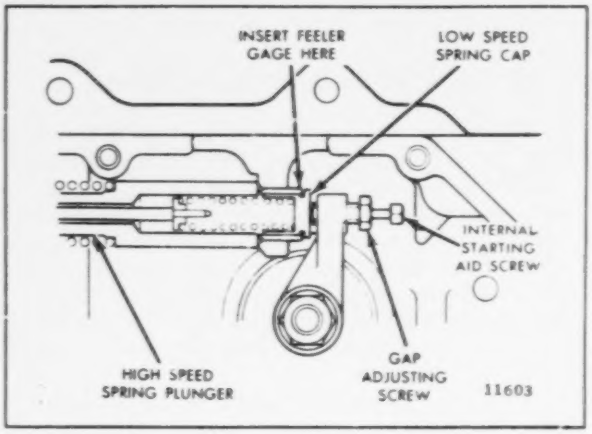

INSERT FEELER GAGE HERE
LOW SPEED SPRING CAP
INTERNAL STARTING AID SCREW
HIGH SPEED SPRING PLUNGER
GAP ADJUSTING SCREW
11603

Fig. 3 - Governor Gap Adjustment

8. Remove gages J 21779 and J 21780 and reinstall the control link lever connecting pins.

9. Install the governor housing and auxiliary control link housing covers.

Proceed with the governor and injector rack control adjustment.

Adjust the Governor Gap

With the engine stopped and at operating temperature, adjust the governor gap as follows:

1. Remove the governor high-speed spring retainer cover.

2. Back out the buffer screw (Fig. 10) until it extends approximately 5/8" from the lock nut.

3. Start the engine and loosen the idle speed adjusting screw lock nut and adjust the idle screw (Fig. 9) to obtain the desired idle speed. Hold the screw and tighten the lock nut to hold the adjustment.

> **IMPORTANT:** Current governors include a starting aid screw threaded into the governor housing.
>
> **NOTE:** The recommended idle speed is 400-450 rpm, but may vary with special engine applications.

4. Stop the engine. Clean and remove the governor cover and lever assembly and the valve rocker covers. Discard the gaskets.

5. Start and run the engine between 800 and 1000 rpm by manual operation of the differential lever.

CAUTION: Do not overspeed the engine.

6. Check the gap between the low-speed spring cap and the high-speed spring plunger (Fig. 3) with a .0015" feeler gage. If the gap setting is incorrect, reset the gap adjusting screw. If the setting is correct, the .0015" movement can be seen by placing a few drops of oil into the governor gap and pressing a screw driver against the gap adjusting screw. Movement of the cap toward the plunger will force the oil from the gap in the form of a small bead.

7. Hold the gap adjusting screw and tighten the lock nut.

8. Recheck the gap and readjust, if necessary.

9. Stop the engine and, using a new gasket, install the governor cover and lever assembly.

Position Injector Rack Control Levers

The position of the injector racks must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Certain engines use spring-loaded injector control tube assemblies which have a yield spring at each injector rack control lever and only one screw and lock nut to keep each injector rack properly positioned. Adjust the single screw and lock nut on each injector rack control lever the same as for the two screw rack control lever (refer to Fig. 3 for 6, 8 and 12V-71 engine governor). Properly positioned injector rack control levers with the engine at full load will result in the following:

1. Speed control lever at the maximum speed position.

2. Governor low speed gap closed.

3. High speed spring plunger on the seat in the governor control housing.

4. Injector fuel control racks in the full-fuel position.

The letters R and L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. Cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the No. 4R injector rack control lever first to establish a guide for adjusting the remaining right bank injector rack control levers.

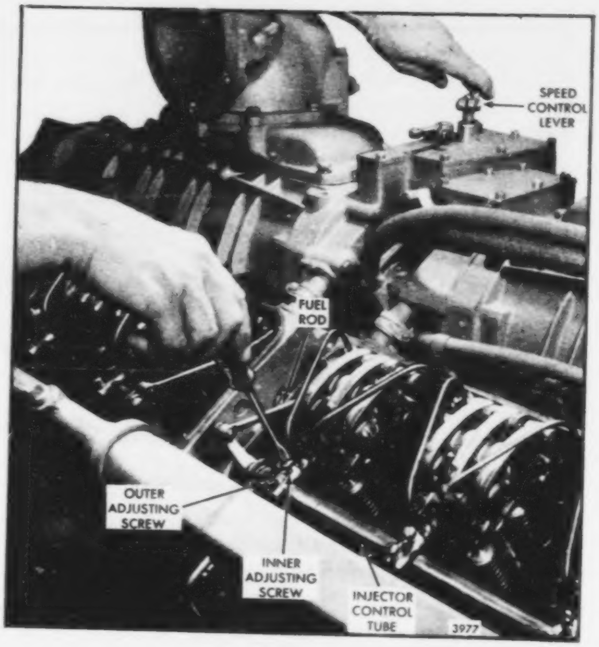


Fig. 4 - Positioning No. 4L Injector Rack Control Lever (Two Screw Assembly)

1. Adjust the idle speed adjusting screw until 1/2" of the threads (12-14 threads) project from the lock nut when the nut is against the high-speed spring plunger.

CAUTION: A false fuel rack setting may result if the idle speed adjusting screw is not backed out as noted above.

NOTE: This adjustment lowers the tension on the low-speed spring so it can be easily compressed. This permits closing the low-speed gap without bending the fuel rods or causing the *yield mechanism springs* to yield or stretch.

2. Back out the buffer screw approximately 5/8", if it has not already been done.

3. Loosen all of the inner and outer injector rack control lever adjusting screws on both cylinder banks. Be sure all of the levers are free on the injector control tubes.

4. Check for any bind in the governor control tube linkage by moving the linkage through its full range of travel.

5. Remove the clevis pins which attach the right rear bank and both left bank fuel rods to the injector control tube levers.

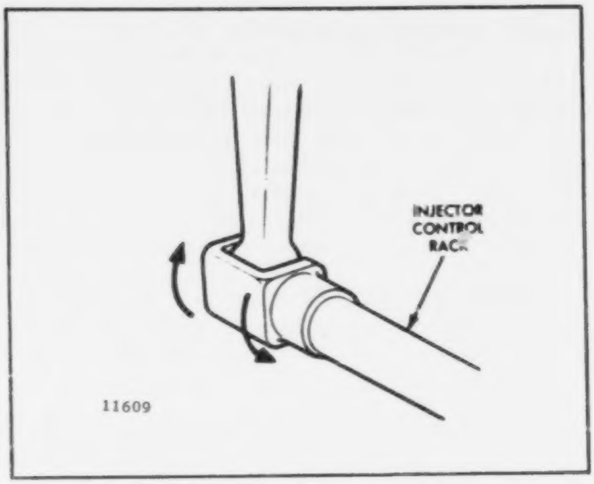


Fig. 5 - Checking Rotating Movement of Injector Control Rack

6. Move the speed control lever to the maximum speed position.

7. Hold it with light finger pressure (Fig. 4) and adjust the No. 4R injector rack by turning the inner adjusting screw down until a slight movement of the control tube is observed or a step-up in effort to turn the screw driver is noted. This will place the rack in the full-fuel position. Turn the outer adjusting screw until it bottoms lightly on the control tube. Then tighten both the inner and outer adjusting screws alternately.

> **CAUTION:** Care should be taken to avoid setting the rack too tight, causing the fuel rod to bend.

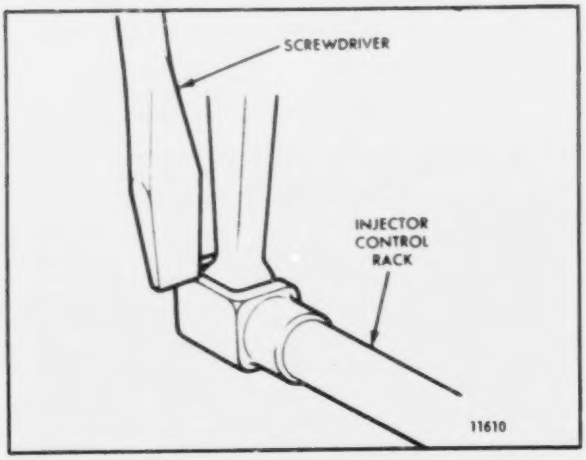


Fig. 6 - Checking Injector Control Rack "Spring"

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lb(3-4 Nm).**

> **IMPORTANT:** The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full load.

8. To be sure of the proper rack adjustment, hold the speed control lever in the maximum speed position and press down on the injector rack with a screw driver or finger tip and note "rotating" movement of the injector control rack (Fig. 5). Hold the speed control lever in the maximum speed position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 6) and when the pressure of the screw driver is released, the control rack should "spring" back upward.

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

The setting is too tight if, when moving the speed control lever from the no-speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

9. Remove the fuel rod-to-control tube lever clevis pin from the right front bank fuel rod and install it on the right rear bank fuel rod and adjust the No. 5R injector rack as outlined in Steps 5, 6 and 7.

10. Repeat Step 9 for adjustment of the No. 4L and 5L injector racks. When the settings are correct, the No. 4R, 5R, 4L and 5L injector racks will be snug on the ball end of the control levers when the injectors are in the full-fuel position.

11. With the fuel rod disconnected from the injector control tube lever, adjust the remaining injector rack control levers on the right front bank. Hold the No. 4R injector rack in the full-fuel position by means of the control tube lever and turn the inner adjusting screw of the No. 3R injector rack control

lever until the injector rack has moved into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

> **NOTE**: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lb(3-4 Nm).**

12. Recheck the No. 4R injector rack to be sure it has remained snug on the ball end of the injector rack control lever. If the rack of the No. 4R injector has become loose, back off the inner adjusting screw slightly on the No. 3R injector rack control lever and tighten the outer adjusting screw. When the settings are correct, both injector racks must respond in the same manner on the ball ends of the control levers when the injector control tube lever is held in the full-fuel position.

13. Position the remaining injector rack control levers on the right front cylinder bank as outlined in Steps 11 and 12.

14. Adjust the remaining injector rack control levers on the right rear, left front and left rear cylinder banks in the same manner as outlined in Steps 11, 12 and 13.

15. Install the four fuel rod-to-control tube lever clevis pins and check the adjustment of the injector rack control levers.

16. Turn the idle speed adjusting screw in until it projects 3/16" from the lock nut, to permit starting the engine.

17. Use new gaskets and replace the valve rocker covers.

Adjust Starting Aid Screw

The starting aid screw (Fig. 7) is threaded into the governor housing of current engines and into the governor gap adjusting screw of early engines. This screw is adjusted to position the injector racks at less than full fuel when the governor speed control lever is in the idle position. The reduced fuel makes starting easier and reduces the amount of smoke on start-up.

> **IMPORTANT:** The effectiveness of the starting aid screw will be eliminated if the speed control lever is advanced to wide open throttle during starting.

After the normal governor *running* gap of .0015" has been set and the injector racks positioned, adjust the starting aid screw.

1. On current turbocharged engines, adjust the external starting aid screw as follows:

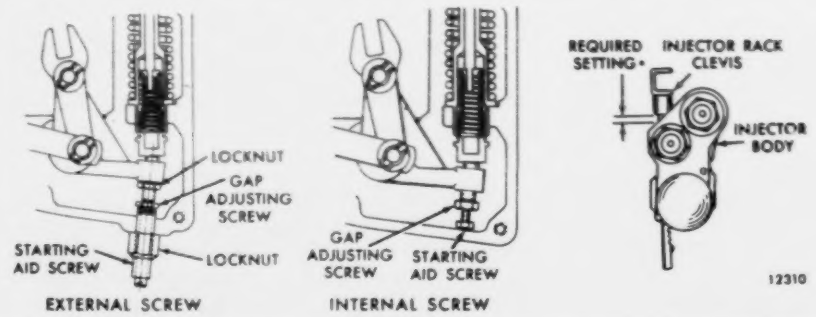
   a. With the engine *stopped*, place the governor stop lever in the *run* position and the speed control lever in the *idle speed* position.

   b. Adjust the starting aid screw to obtain the required setting between the shoulder on the injector rack clevis and the injector body (Fig. 7). Select the proper gage and measure the setting at any convenient cylinder. When the starting aid screw is properly adjusted, the gage should have a small clearance of 1/64" (.397 mm) in the space along the injector rack shaft between the rack clevis and the injector body.

   c. After completing the adjustment, hold the starting aid screw and tighten the lock nut.

   d. Check the injector rack clevis-to-body clearance after performing the following.

      1. Position the stop lever in the *run* position.



INJECTOR	GAGE SETTING •	TOOL NUMBER
S 80	.345"	J 24889
N 60	.345"	J 24889
N 65	.385"	J 24882
N 70	.385"	J 24882
N 75	.385"	J 24882
N 80	.385"	J 24882
N 90	.454"	J 23190
C 65	.385"	J 24882
C 80	.385"	J 24882
M 70	.385"	J 24882
M 95	.454"	J 23190

Fig. 7 - Starting Aid Screw Adjustment

2. Move the speed control lever from the *idle speed* position to the *maximum speed* position.

3. Return the speed control lever to the *idle speed* position.

NOTE: Movement of the speed control lever is to take-up the clearance in the governor linkage. The injector rack clevis-to-body clearance can be increased by turning the starting aid screw farther in against the gap adjusting screw, or reduced by backing it out.

IMPORTANT: The starting aid screw will be ineffective if the speed control lever is advanced toward wide open throttle during start-up.

2. On early turbocharged engines, adjust the internal starting aid screw, as follows:

a. With the engine *stopped*, place the governor stop lever in the *run* position and the speed control lever in the *idle* position.

b. Hold the gap adjusting screw, to keep it from turning, and adjust the starting aid screw to obtain the required setting between the shoulder on the injector rack clevis and the injector body (Fig. 7). The setting is measured at the No. 3R injector rack clevis.

c. Check the injector rack clevis-to-body clearance after performing the following:

1. Position the stop lever in the *run* position.

2. Move the speed control lever from the *idle* position to the *maximum speed* position.

3. Return the speed control lever to the *idle* position.

NOTE: Movement of the governor speed control lever is to take-up clearances in the governor linkage. The clevis-to-body clearance can be increased by backing out the starting aid screw or reduced by turning it farther into the gap adjusting screw.

d. Start the engine and re-check the running gap (.0015″) and, if necessary, reset it and re-position the injector racks. Then stop the engine.

e. Use a new gasket and replace the governor cover and lever assembly. Tighten the screws.

3. Use new gaskets and replace the valve rocker covers.

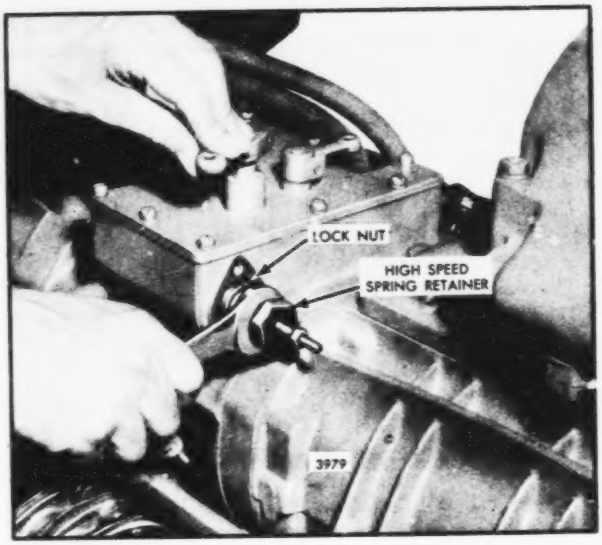


Fig. 8 - Adjusting Maximum No-Load Speed

Adjust Maximum No-Load Engine Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the option plate, set the maximum no-load speed as follows:

NOTE: Be sure the buffer screw projects 5/8″ from the lock nut to prevent interference while adjusting the maximum no-load speed.

1. Loosen the spring retainer lock nut (Fig. 8) and back off the high-speed spring retainer approximately five turns.

2. With the engine running at operating temperature and no-load on the engine, place the speed control lever in the maximum speed position. Turn the high-speed spring retainer until the engine is operating at the recommended no-load speed.

3. Hold the high-speed spring retainer and tighten the lock nut.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. With the engine running, at normal operating temperature and with the buffer screw backed out to avoid contact with the differential lever, turn the idle speed adjusting screw (Fig. 9) until the engine is

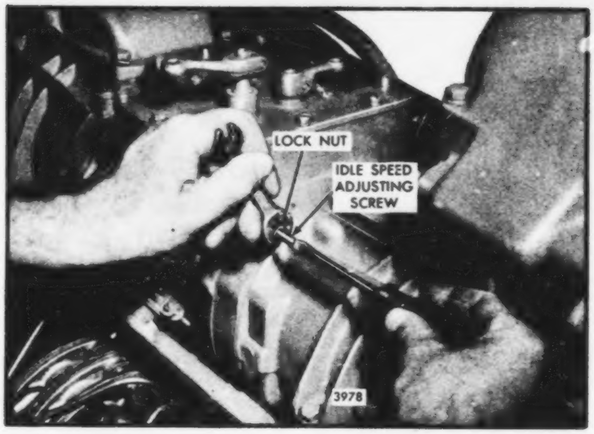


Fig. 9 - Adjusting Engine Idle Speed

operating approximately 15 rpm below the recommended idle speed.

> **IMPORTANT:** It may be necessary to use the buffer screw to eliminate the engine roll. Back out the buffer screw, after the idle speed is established, to the previous setting (5/8").

> **NOTE:** The recommended idle speed is 400-450 rpm, but may vary with certain engine applications.

2. Hold the idle screw and tighten the lock nut.

3. Install the high-speed spring retainer cover and tighten the two bolts.

Adjust Buffer Screw

With the idle speed properly set, adjust the buffer screw as follows:

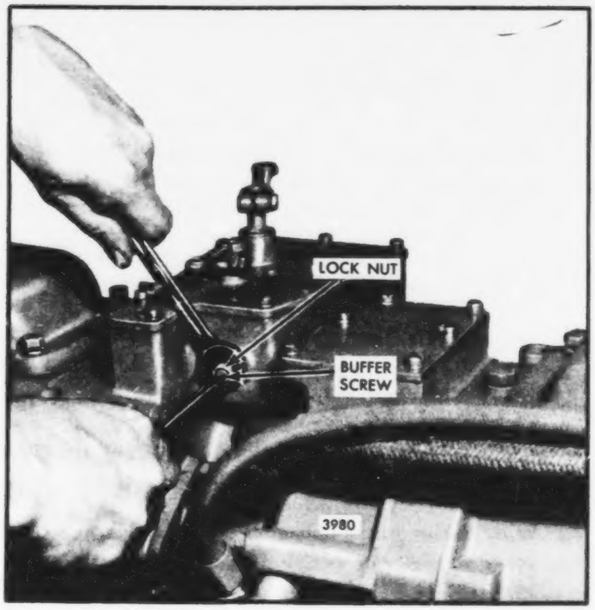


Fig. 10 - Adjusting Buffer Screw

1. With the engine running at normal operating temperature, turn the buffer screw in so it contacts the differential lever as lightly as possible and still eliminates the engine roll (Fig. 10).

> **NOTE:** Do not increase the engine idle speed more than 15 rpm with the buffer screw.

2. Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the buffer screw until the increase is less than 25 rpm.

3. Hold the buffer screw and tighten the lock nut.

LIMITING SPEED MECHANICAL GOVERNOR

(Fast Idle Cylinder)

The limiting speed governor equipped with a fast idle air cylinder is used on certain engines where the engine powers both a vehicle and auxiliary equipment.

The fast idle system consists of a fast idle air cylinder installed in place of the buffer screw and a throttle locking air cylinder mounted on a bracket fastened to the governor cover (Fig. 1). An engine shutdown air cylinder, if used, is also mounted on the governor cover.

The fast idle air cylinder and the throttle locking air cylinder are actuated at the same time by air from a common air line. The engine shutdown air cylinder is connected to a separate air line.

The air supply for the fast idle air cylinder is usually controlled by an air valve actuated by an electric solenoid. The fast idle system should be installed so that it will function only when the parking brake system is in operation to make it tamper-proof.

The accelerator-to-governor throttle linkage is connected to a yield link so the operator cannot overcome the force of the air cylinder holding the speed control lever in the idle position while the engine is operating at the single fixed high idle speed.

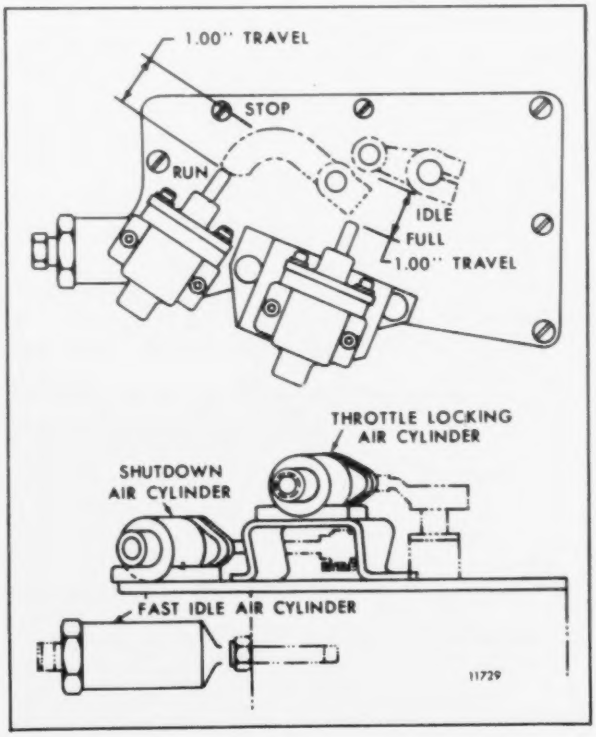

1.00'' TRAVEL
STOP
RUN
IDLE
FULL
1.00'' TRAVEL
THROTTLE LOCKING AIR CYLINDER
SHUTDOWN AIR CYLINDER
FAST IDLE AIR CYLINDER
11729

Fig. 1 - Governor with Fast Idle Cylinder

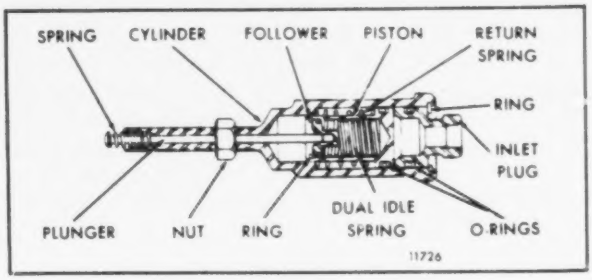

SPRING
CYLINDER
FOLLOWER
PISTON
RETURN SPRING
RING
INLET PLUG
PLUNGER
NUT
RING
DUAL IDLE SPRING
O-RINGS
11726

Fig. 2 - Fast Idle Air Cylinder

Operation

During normal operation, the governor functions as a limiting speed governor.

For operation of auxiliary equipment, the vehicle is stopped and the parking brake set. Then, with the engine running, the low-speed switch is placed in the ON position. When the fast idle air cylinder is actuated, the force of the dual idle spring (Fig. 2) is added to the force of the governor low-speed spring, thus increasing the engine idle speed.

The governor now functions as a constant speed governor at the high idle speed setting, maintaining a near constant engine speed regardless of the load within the capacity of the engine. The fast idle system

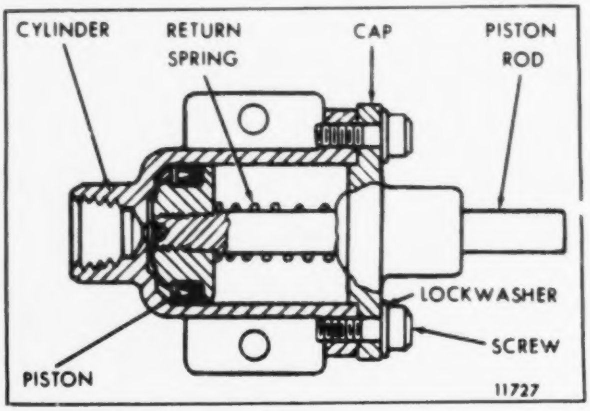

CYLINDER
RETURN SPRING
CAP
PISTON ROD
LOCKWASHER
SCREW
PISTON
11727

Fig. 3 - Throttle Locking Air Cylinder

provides a single fixed high idle speed that is not adjustable, except by disassembling the fast idle air cylinder and changing the dual idle spring. As with all mechanical governors, when load is applied, the engine speed will be determined by the governor droop.

Adjust Governor

Before adjusting the governor gap, back out the de-energized fast idle air cylinder until it will not interfere with the governor adjustments. After the normal idle speed setting is made, adjust the de-energized fast idle air cylinder in the same manner as outlined for adjustment of the buffer screw.

The throttle locking air cylinder is adjusted on its mounting bracket so it will lock the throttle in the idle position when it is activated, but will not limit the throttle movement when not activated.

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6, 8 and 12V ENGINES

The single-weight variable speed governor is mounted on the front of the engine and is driven by the blower rotor.

After adjusting the exhaust valves and timing the fuel injectors, adjust the variable speed mechanical governor and injector rack control levers.

> **NOTE:** Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, reconnect and adjust the supplementary governing device.

Adjust Governor Gap

With the engine stopped and at normal operating temperature, adjust the governor gap as follows:

1. Disconnect any linkage attached to the governor levers.

2. Back out the buffer screw until it extends approximately 5/8" from the lock nut.

3. Clean and remove the governor cover and valve rocker covers. Discard the gaskets.

4. Place the speed control lever in the maximum speed position.

5. Insert a .006" feeler gage between the spring plunger and the plunger guide as shown in Fig. 1. If required, loosen the lock nut and turn the adjusting screw until a slight drag is noted on the feeler gage.

6. Hold the adjusting screw and tighten the lock nut. Check the gap again and, if necessary, readjust.

7. Use a new gasket and install the governor cover. Tighten the screws.

Position Injector Rack Control Levers

The position of the injector control rack levers must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Certain engines use spring-loaded injector control tube assemblies which have a yield spring at each injector rack control lever and only one screw and lock nut to keep each injector rack properly positioned. Adjust the single screw and lock nut on each injector rack control lever the same as for the two screw rack control lever.

Properly positioned injector rack control levers, with the engine at full load, will result in the following:

1. Speed control lever at the maximum speed position.

2. Stop lever in the Run position.

3. High speed spring plunger is within .005" to .007" of its seat in the governor control housing.

4. Injector fuel control racks in the full fuel position.

The letters R and L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. The cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the

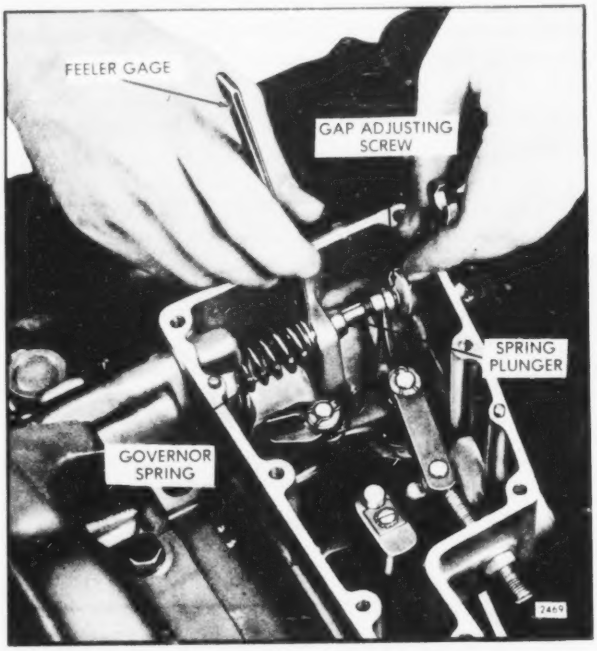


Fig. 1 - Adjusting Governor Gap

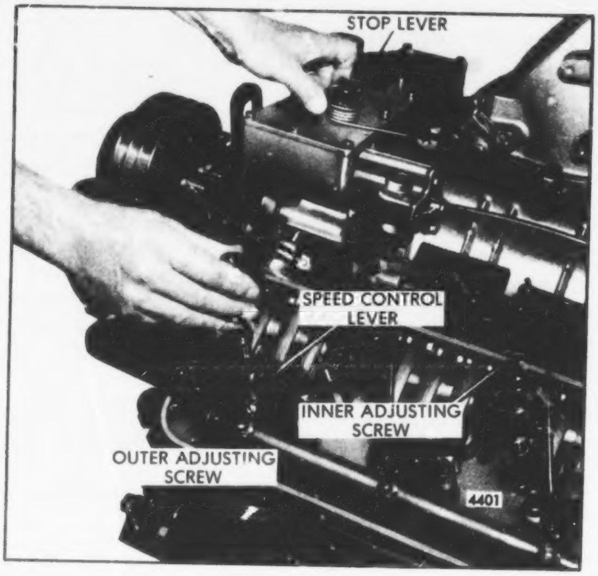


Fig. 2 - Positioning No. 1 Injector Rack Control Lever

No. 1L injector rack control lever first to establish a guide for adjusting the remaining control levers.

1. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.

2. Loosen all of the inner and outer injector rack control lever adjusting screws on both injector control tubes. Be sure all of the injector rack control levers are free on the injector control tubes.

3. Move the speed control lever to the maximum speed position.

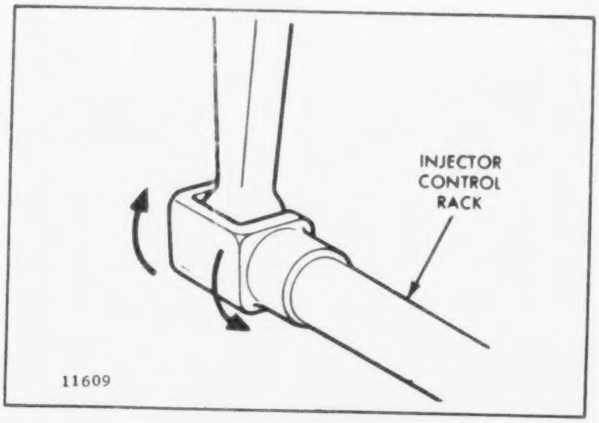


Fig. 3 - Checking Rotating Movement of Injector Control Rack

4. Move the governor stop lever to the "run" position and hold it in that position with light finger pressure. Turn the inner adjusting screw of the No. 1L injector rack control lever down until a slight movement in the governor stop lever is noted. Turn down the outer adjusting screw until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws (Fig. 2).

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

> **IMPORTANT:** The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full-load.

5. To be sure of the proper rack adjustment, hold the stop lever in the run position and press down on the injector rack with a screw driver or finger tip and note "rotating" movement of the injector control rack (Fig. 3) when the stop lever is in the run position. Hold the stop lever in the run position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 4) and when the pressure of the screw driver is released, the control rack should "spring" back upward.

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

The setting is too tight if, when moving the stop lever from the stop to the run position, the injector rack becomes tight before the stop lever reaches the end of its travel. This will result in a step-up in effort required to move the stop lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

6. Remove the clevis pin from the fuel rod and the left bank injector control tube lever.

7. Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the 1R injector rack control lever as previously outlined in Step 4.

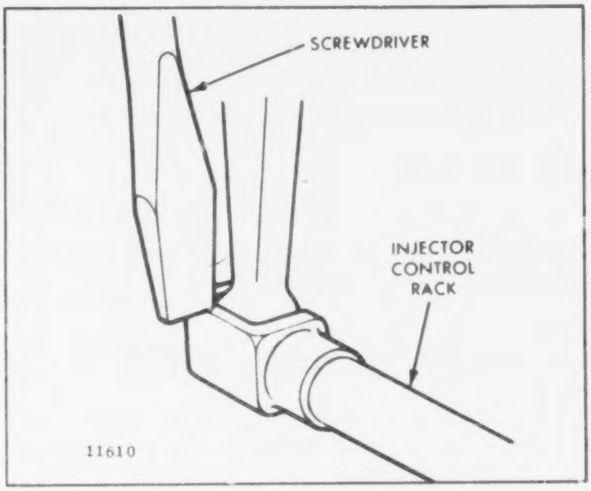


Fig. 4 - Checking Injector Control Rack "Spring"

8. Insert the clevis pin in the fuel rod and the left bank injector control tube lever. Repeat the check on the 1L and 1R injector rack control levers as outlined in Step 5. Carefully observe and eliminate any deflection which occurs at the bend in the fuel rod where it enters the cylinder head.

9. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rods and the injector control tube levers, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube, and proceed as follows:

a. Turn down the inner adjusting screw of the injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

b. Turn down the outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

c. While still holding the control tube lever in the full-fuel position, adjust the inner and outer adjusting screws to obtain the same condition as outlined in Step 5. Tighten the screws.

CAUTION: Once the No. 1L and No. 1R injector rack control levers are adjusted, do not try to alter their settings. All adjustments are made on the remaining control racks.

10. When all of the injector rack control levers are adjusted, recheck their settings. With the control tube lever in the full-fuel position, check each control rack as in Step 5. All of the control racks must have the same "spring" condition with the control tube lever in the full-fuel position.

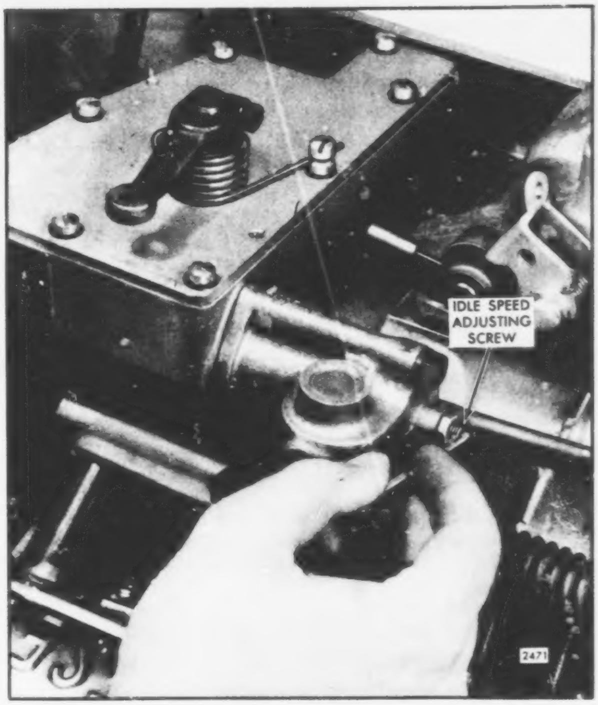


Fig. 5 - Adjusting Idle Speed

11. Insert the clevis pin in the fuel rods and the injector control tube levers.

12. Use new gaskets and install the valve rocker covers.

Adjust Maximum No-Load Engine Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the engine option plate, set the maximum no-load speed as outlined below.

Start the engine and, after it reaches normal operating temperature, use an accurate hand tachometer to

Variable Speed Governor Adjustment		
Full-Load Speed*	Stops	Shims
1200-1750	2	Up to .325"
1750-2100	1	in shims
2000-2300	0	maximum

*No-load speed is 125-200 rpm above full-load speed depending upon engine application.

TABLE 1

determine the maximum no-load speed of the engine. Then stop the engine and make the following adjustments, if required:

1. Disconnect the booster spring and the stop lever spring.

2. Remove the variable speed spring housing and the spring retainer from the governor housing.

3. Refer to Table 1 and determine the stops or shims required for the desired no-load speed.

4. Install the variable speed spring retainer and housing and tighten the two bolts.

5. Connect the booster spring and the stop lever spring. Start the engine and recheck the maximum no-load speed.

6. If required, add or remove shims to obtain the necessary operating speed. For each .001" shim added, the operating speed will increase approximately 1 rpm.

> **IMPORTANT:** If the maximum no-load speed is raised or lowered more than 50 rpm by the installation or removal of shims, recheck the governor gap. If readjustment of the governor gap is required, the position of the injector racks must be rechecked.

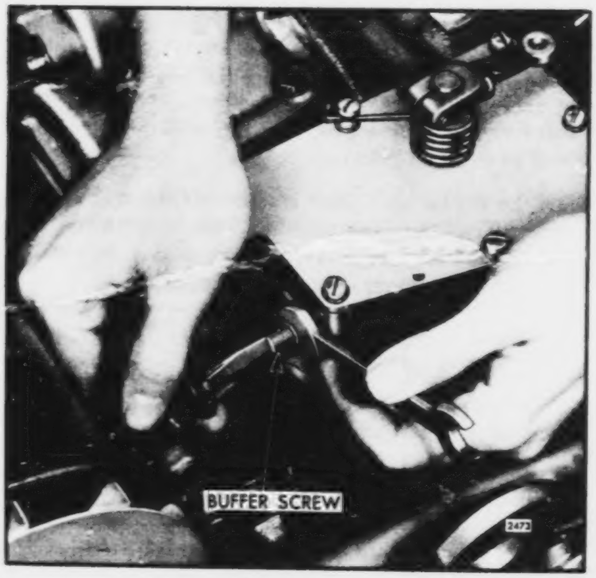


Fig. 6 - Adjusting Buffer Screw

> **NOTE:** Governor stops are used to limit the compression of the governor spring, which determines the maximum speed of the engine.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. Place the stop lever in the "run" position and the speed control lever in the "idle" position.

2. With the engine running at normal operating temperature, back out the buffer screw to avoid contact with the differential lever.

3. Loosen the lock nut and turn the idle speed adjusting screw (Fig. 5) until the engine is operating at approximately 15 rpm below the recommended idle speed.

> **NOTE:** The recommended idle speed is 550 rpm, but may vary with special engine applications.

4. Hold the idle speed adjusting screw and tighten the lock nut.

Adjust Buffer Screw

1. With the engine running at normal operating temperatures, turn the buffer screw "in" (Fig. 6) so

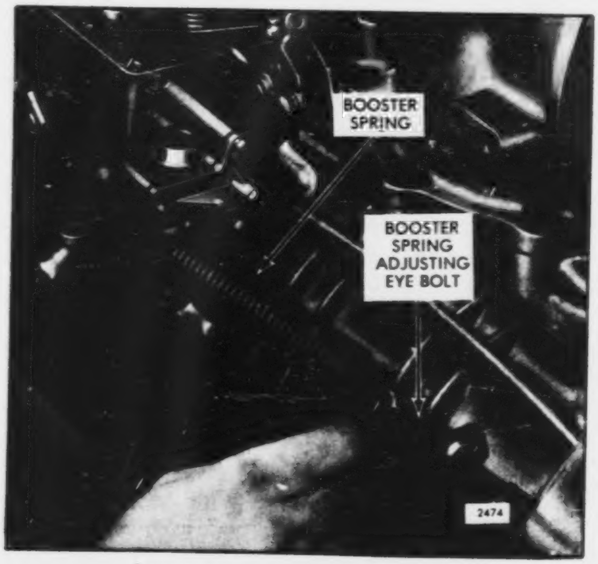


Fig. 7 - Adjusting Booster Spring

that it contacts the differential lever as lightly as possible and still eliminates engine roll.

> **NOTE:** Do not raise the engine idle speed more than 15 rpm with the buffer screw.

2. Hold the buffer screw and tighten the lock nut.

Adjust Booster Spring

With the idle speed adjusted, adjust the booster spring as follows:

1. Move the speed control lever to the idle speed position.

2. Refer to Fig. 7 and loosen the booster spring retaining nut on the speed control lever. Loosen the lock nuts on the eye bolt at the opposite end of the booster spring.

3. Move the bolt in the slot of the speed control lever until the center of the bolt is on or slightly over center (toward the idle speed position) of an imaginary line through the bolt, lever shaft, and eye bolt. Hold the bolt and tighten the lock nut.

4. Start the engine and move the speed control lever to the maximum speed position and release it. The speed control lever should return to the idle position. If it does not, reduce the tension on the booster spring. If it does, continue to increase the spring tension until the point is reached that it will not return to idle. Then reduce the tension until it does return to idle and tighten the lock nut on the eye bolt. This setting will result in the minimum force required to operate the speed control lever.

5. Connect the linkage to the governor levers.

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

16V-71 ENGINE

The governor (Fig. 1) on the 16V engine is mounted on and driven from the front end of the rear blower.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and injector rack control levers.

If the engine or governor has been overhauled, or the injector control linkage has been disturbed, the control link levers in the governor housing and auxiliary control link housing must be aligned before proceeding with the engine tune-up. Refer to Fig. 2 and position the control link levers as follows:

1. Disconnect the linkage to the governor speed control and stop levers.

2. Remove the covers from the governor housing and auxiliary control link housing.

3. Disconnect the adjustable link from the lever in the auxiliary control link housing.

4. Remove the connecting pin from the auxiliary governor control link lever.

5. Install gage J 21779 so it extends through the lever and fuel rod and into the gage hole in the bottom of the housing. With the gage in place, the auxiliary control link lever will be in the mid-travel position.

6. Remove the connecting pin from the control link lever in the governor housing and install gage J 21780. Install the gage so the pin extends through the connecting link, control lever and fuel rod and the governor housing dowel pin extends into the small hole in the gage. Then install a governor cover bolt as shown in Fig. 2 to lock the gage in place. With gage J 21780 in place, the governor control link lever will be in the mid-travel position and parallel to the auxiliary control link lever.

7. Adjust the length of the adjustable connecting link to retain the lever positions obtained in Steps 5 and 6 and install the link.

8. Remove gages J 21779 and J 21780 and reinstall the control link lever connecting pins.

9. Install the governor housing and auxiliary control link housing covers.

Proceed with the governor and injector rack control adjustment.

Adjust Governor Gap

With the engine stopped and at normal operating temperature, adjust the governor gap as follows:

1. Clean and remove the governor cover and the valve rocker covers. Discard the gaskets.

2. Back out the buffer screw until it extends approximately 5/8″ from the lock nut.

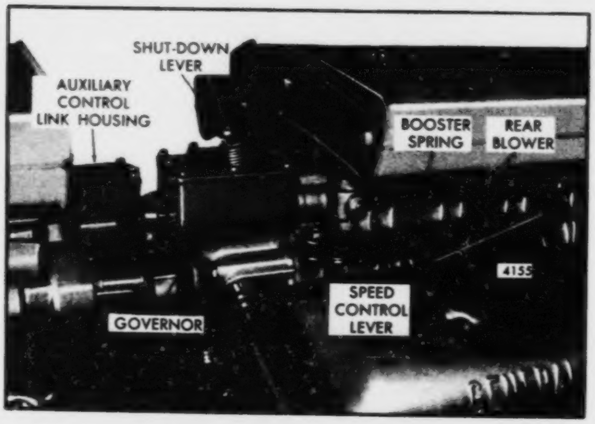

SHUT-DOWN LEVER
AUXILIARY CONTROL LINK HOUSING
BOOSTER SPRING
REAR BLOWER
4155
SPEED CONTROL LEVER
GOVERNOR

Fig. 1 - Governor Mounting

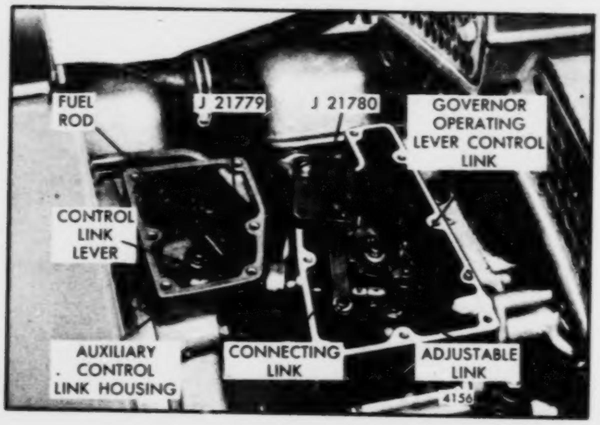

FUEL ROD
J 21779
J 21780
GOVERNOR OPERATING LEVER CONTROL LINK
CONTROL LINK LEVER
AUXILIARY CONTROL LINK HOUSING
CONNECTING LINK
ADJUSTABLE LINK
4156

Fig. 2 - Control Link Levers In Position

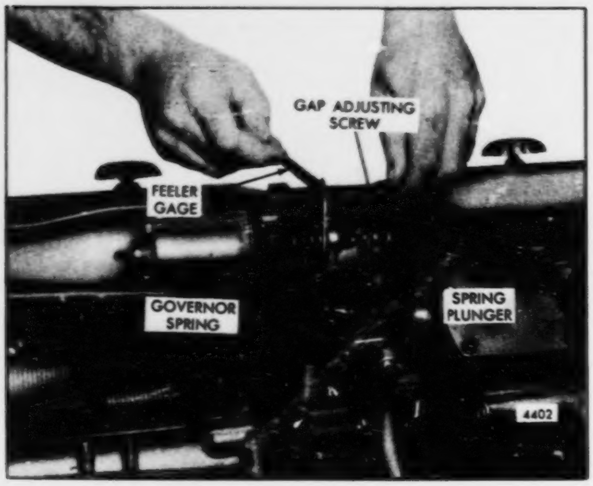


Fig. 3 - Adjusting Governor Gap

3. Place the speed control lever in the maximum speed position.

4. Insert a .006" feeler gage between the spring plunger and the plunger guide as shown in Fig. 3. If required, loosen the lock nut and turn the adjusting screw until a slight drag is noted on the feeler gage.

5. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust if necessary.

6. Use a new gasket and install the governor cover.

Position Injector Rack Control Levers

The position of the injector control rack levers must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Certain engines use spring-loaded injector control tube assemblies which have a yield spring at each injector rack control lever and only one screw and lock nut to keep each injector rack properly positioned. Adjust the single screw and lock nut on each injector rack control lever the same as for the two screw rack control lever.

Properly positioned injector rack control levers with the engine at full-load will result in the following:

1. Speed control lever at the maximum speed position.

2. Stop lever in the Run position.

3. High speed spring plunger is within .005" to .007" of its seat in the governor control housing.

4. Injector fuel control racks in the full-fuel position.

The letters R and L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. Cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the No. 4R injector rack control lever first to establish a guide for adjusting the remaining injector rack control levers.

1. Remove the clevis pins which attach the right rear bank and both left bank fuel rods to the injector control tube levers.

2. Loosen all of the inner and outer injector rack control lever adjusting screws on both cylinder banks. Be sure all of the levers are free on the injector control tubes.

3. Move the speed control lever to the maximum speed position.

4. Move the stop lever in the RUN position and hold it in that position with a light finger pressure. Turn the inner adjusting screw of the No. 4R injector rack control lever down until a slight movement of the stop lever is noted (Fig. 4). Turn down the outer adjusting screw until it bottoms lightly on the control tube. Then

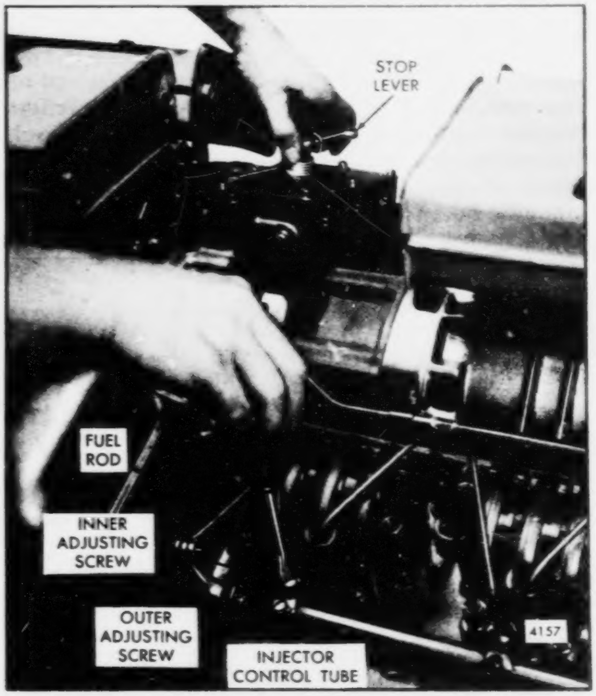


Fig. 4 - Positioning No. 4R Injector Rack Control Lever

alternately tighten both the inner and outer adjusting screws.

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

> **IMPORTANT:** The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full-load.

5. To be sure of the proper rack adjustment, hold the stop lever in the RUN position and press down on the injector rack with a screw driver or finger tip and note the "rotating" movement of the injector control rack (Fig. 5). Hold the stop lever in the run position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 6) and when the pressure of the screw driver is released, the control rack should "spring" back upward.

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

The setting is too tight if, when moving the stop lever from the stop to the run position, the injector rack becomes tight before the stop lever reaches the end of its travel. This will result in a step-up in effort required to move the stop lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

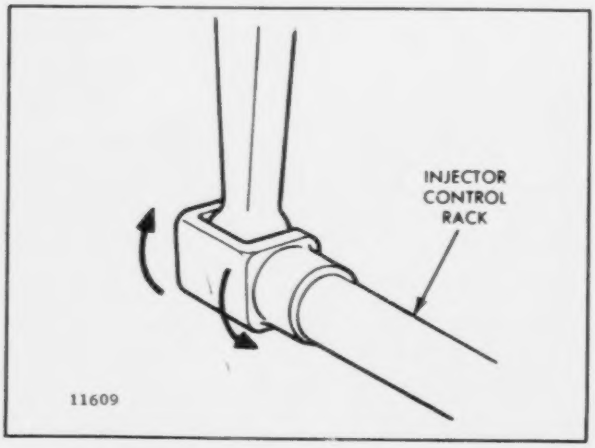


Fig. 5 - Checking Rotating Movement of Injector Control Rack

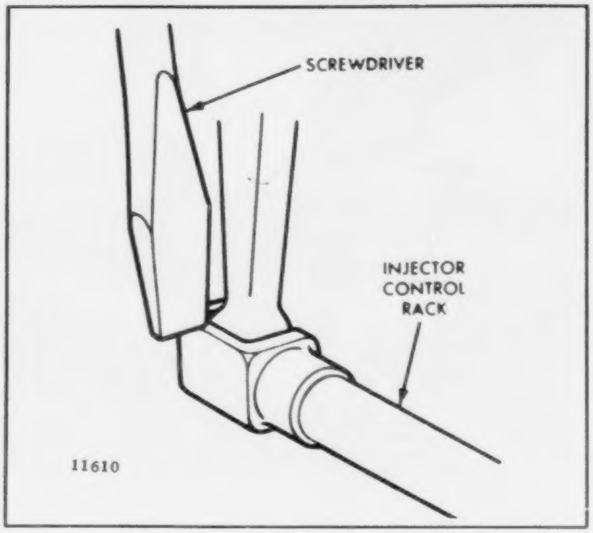


Fig. 6 - Checking Injector Control Rack "Spring"

6. Remove the fuel rod-to-control tube lever clevis pin from the right front bank fuel rod and install it on the right rear bank fuel rod and adjust the No. 5R injector rack as outlined in Steps 4 and 5.

7. Repeat Step 6 for adjustment of the No. 4L and 5L injector racks. When the settings are correct, the No. 4R 5R, 4L and 5L injector racks will be snug on the ball end of the control levers when the injectors are in the full-fuel position.

8. With the fuel rod disconnected from the injector control tube lever, adjust the remaining injector rack control levers on the right front bank. Hold the No. 4R injector rack in the full-fuel position by means of the control tube lever and turn the inner adjusting screw of the No. 3R injector rack control lever until the injector rack has moved into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

9. Recheck the No. 4R injector rack to be sure it has remained snug on the ball end of the injector rack control lever. If the rack of the No. 4R injector has become loose, back off the inner adjusting screw slightly on the No. 3R injector rack control lever and

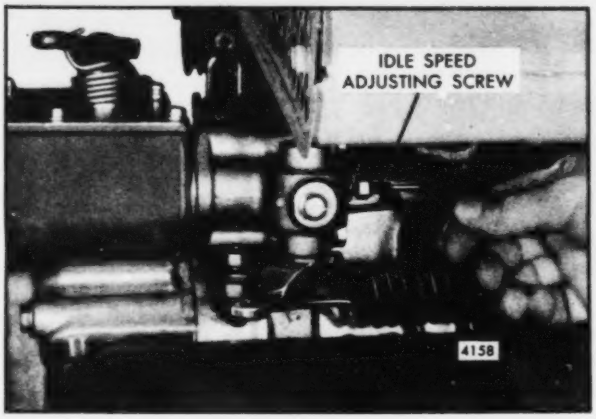


Fig. 7 - Adjusting Idle Speed

tighten the outer adjusting screw. When the settings are correct, both injector racks must respond in the same manner on the ball ends of the control levers when the injector control tube lever is held in the full-fuel position.

10. Position the remaining injector rack control levers on the right front cylinder bank as outlined in Steps 8 and 9.

11. Adjust the remaining injector rack control levers on the right rear, left front and left rear cylinder banks in the same manner as outlined in Steps 8, 9 and 10.

12. Install the four fuel rod-to-control tube lever clevis pins and check the adjustment of the injector rack control levers.

13. Use new gaskets and install the valve rocker covers.

Adjust Maximum No-Load Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the engine option plate, set the maximum no-load speed as outlined below.

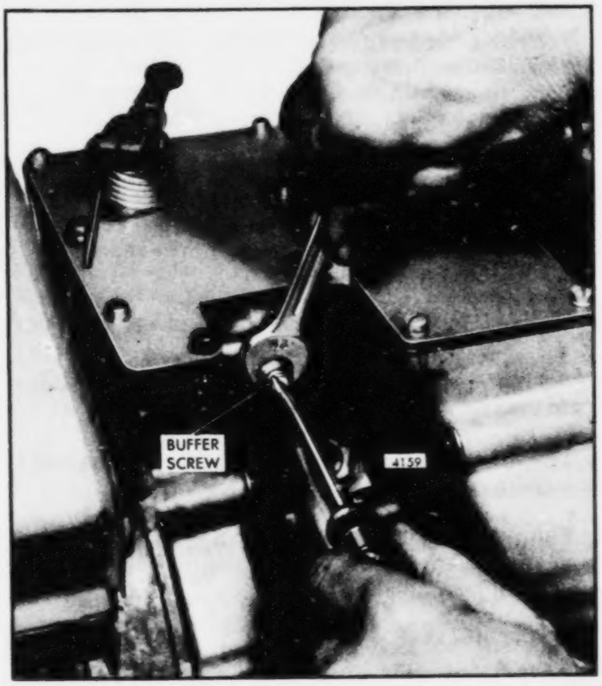


Fig. 8 - Adjusting Buffer Screw

Variable Speed Governor Adjustment		
Full-Load Speed*	Stops	Shims
1200-1750	2	Up to .325" in shims maximum
1750-2100	1	
2100-2300	0	

*No-load speed is 150-225 rpm above full-load speed depending upon engine application.

TABLE 1

Start the engine and, after it reaches normal operating temperature, use an accurate hand tachometer to determine the maximum no-load speed of the engine. Then stop the engine and make the following adjustments, if required:

1. Disconnect the booster spring and the stop lever spring.

2. Remove the variable speed spring housing and the spring retainer from the governor housing.

3. Refer to Table 1 and determine the stops or shims required for the desired no-load speed.

4. Install the variable speed spring retainer and housing and tighten the two bolts.

5. Connect the booster spring and the stop lever spring. Start the engine and recheck the maximum no-load speed.

6. If required, add or remove shims to obtain the necessary operating speed. For each .001" shim added, the operating speed will increase approximately 1 rpm.

IMPORTANT: If the maximum no-load speed is raised or lowered more than 50 rpm by the installation or removal of shims, recheck the governor gap. If readjustment of the governor gap is required, the position of the injector racks must be rechecked.

NOTE: Governor stops are used to limit the compression of the governor spring, which determines the maximum speed of the engine.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. Place the speed control lever in the *idle* position and the stop lever in the *run* position.

2. With the engine running at normal operating temperature, back out the buffer screw to avoid contact with the differential lever.

3. Loosen the lock nut and turn the idle speed adjusting screw (Fig. 7) until the engine is operating at approximately 15 rpm below the recommended idle speed.

NOTE: The recommended idle speed is 550 rpm, but may vary with special engine applications.

4. Hold the idle speed adjusting screw from turning and tighten the lock nut.

Adjust Buffer Screw

1. With the engine running at normal operating temperature, turn the buffer screw "in" (Fig. 8) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

NOTE: Do not raise the idle speed more than 15 rpm with the buffer screw.

2. Hold the buffer screw from turning and tighten the lock nut.

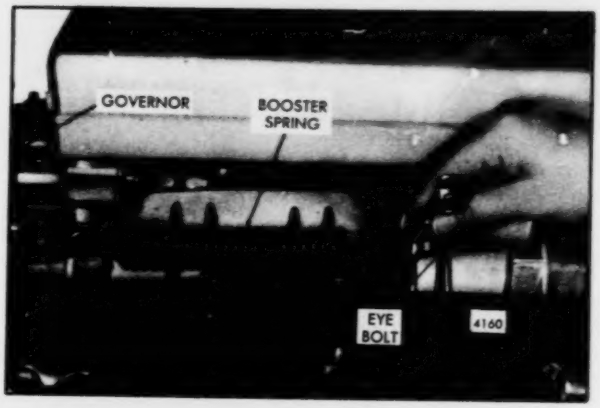


Fig. 9 – Adjusting Booster Spring

Adjust Booster Spring

With the idle speed adjusted, adjust the booster spring as follows:

1. Move the speed control lever to the idle speed position.

2. Refer to Fig. 9 and loosen the nut on the booster spring retaining bolt on the governor speed control lever. Loosen the lock nuts on the eye bolt at the opposite end of the booster spring.

3. Move the bolt in the slot of the speed control lever until the center of the bolt is on or slightly over center (toward the idle speed position) of an imaginery line through the bolt, lever shaft and eye bolt. Hold the bolt from turning and tighten the lock nut.

4. Start the engine and move the speed control lever to the maximum speed position and release it. The speed control lever should return to the idle position. If it does not, reduce the spring tension. If the lever does return to the idle position, increase the tension of the spring until the lever will not return to idle. Then reduce the tension until the lever will return to idle and tighten the lock nut on the eye bolt. This setting will result in a minimum force required to operate the speed control lever.

SUPPLEMENTARY GOVERNING DEVICE ADJUSTMENT

ENGINE LOAD LIMIT DEVICE

Engines with mechanical governors may be equipped with a load limit device (Fig. 1) to reduce the maximum horsepower.

This device consists of a load limit screw threaded into a plate mounted between two adjacent rocker arm shaft brackets and a load limit lever clamped to the injector control tube.

The load limit device is located between the No. 1 and No. 2 cylinders on *each* cylinder bank of a 6V engine, between the No. 2 and No. 3 cylinders on *each* cylinder bank of an 8V engine, or between the No. 3 and No. 4 cylinders on *each* cylinder bank of a 12V engine. On the 16V engine, four load limit devices are used (one on each cylinder head): between the No. 2 and No. 3 cylinder and between the No. 6 and No. 7 cylinder on each bank.

When properly adjusted for the maximum horsepower desired, this device limits the travel of the injector control racks and thereby the fuel output of the injectors.

Adjustment

After the engine tune-up is completed, make sure the load limit devices are properly installed as shown in Fig. 1. Make sure the counterbores in the adjusting screw plates are up. The rocker arm shaft bracket bolts which fasten the adjusting screw plate to the brackets are tightened to 75–85 lb-ft (102–115 Nm) torque (all other rocker arm shaft bracket bolts are tightened to 90–100 lb-ft or 122–136 Nm torque). Then adjust the load limit device, on each cylinder head, as follows:

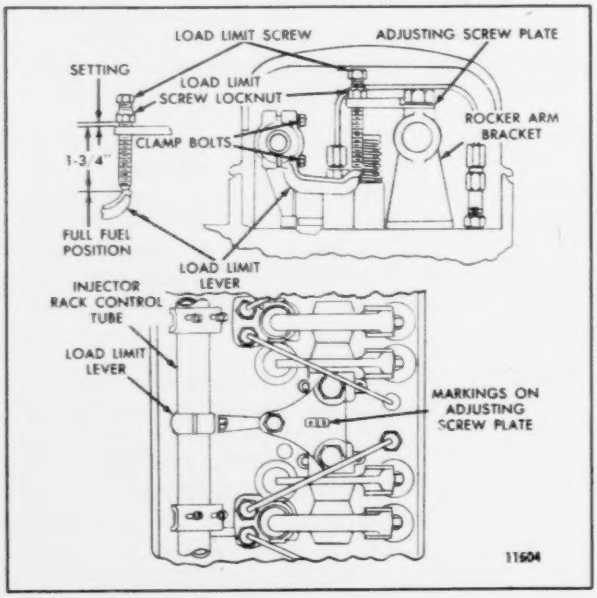


Fig. 1 - Engine Load Limit Device

1. Loosen the load limit screw lock nut and remove the screw.

2. Loosen the load limit lever clamp bolts so the lever is free to turn on the injector rack control tube.

3. With the screw out of the plate, adjust the load screw lock nut so the bottom of the lock nut is 1 3/4" from the bottom of the load limit screw (Fig. 1) for the initial setting.

4. Thread the load limit screw into the adjusting screw plate until the lock nut *bottoms* against the top of the plate.

5. Hold the injector rack control tube in the full-fuel position and place the load limit lever against the bottom of the load limit screw. Then tighten the load limit lever clamp bolts.

6. Check to ensure that the injector racks will just go into the full-fuel position -- readjust the load limit lever if necessary.

7. Hold the load limit screw to keep it from turning, then *set* the lock nut until the distance between the bottom of the lock nut and the top of the adjusting screw plate corresponds to the dimension (or number of turns) stamped on the plate. Each full turn of the screw equals .042, or .007" for each flat on the hexagon head.

> **NOTE:** If the plate is not stamped, adjust the load limit screw while operating the engine on a dynamometer test stand and note the number of turns required to obtain the desired horsepower. Then stamp the plate accordingly.

8. Thread the load limit screw into the plate until the lock nut *bottoms* against the top of the plate.

9. Hold the load limit screw to keep it from turning, then tighten the lock nut to secure the setting.

POWER CONTROL DEVICE

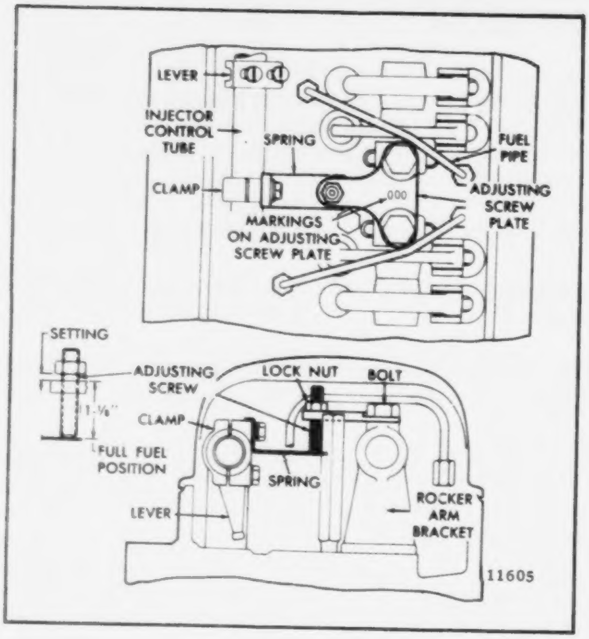


Fig. 2 - Power Control Device

The power control (torque limiting) device (Fig. 2) is used to limit the maximum horsepower output at the wheels without diminishing the performance at lower speeds where full power may be required. It limits the horsepower at, or just below, the normal full-load governed speed. These limiting characteristics are proportionately lessened as the engine speed is reduced and the horsepower required is reduced.

This device, one on each cylinder bank, consists of an adjusting screw threaded into a plate mounted between two adjacent rocker arm shaft brackets and a spring attached to a clamp on the injector control tube.

> **NOTE:** The rocker arm shaft bracket bolts that retain the adjusting screw plates are tightened to 75-85 lb-ft (102-115 Nm) torque; all other rocker arm shaft bracket bolts are tightened to 90-100 lb-ft (122-136 Nm) torque.

The power control device is located between the No. 1 and No. 2 cylinders on *each* cylinder bank of a 6V engine, between the No. 2 and No. 3 cylinders on *each* cylinder bank of an 8V engine, or between the No. 3 and No. 4 cylinders on *each* cylinder bank of a 12V engine.

Adjustment

After the engine tune-up is completed, adjust the power control device on both cylinder banks as follows:

1. Place the vehicle on a chassis dynamometer and check the maximum wheel horsepower.

2. Loosen the power control spring attaching bolts. Then adjust both springs until they project parallel to the cylinder heads when the injector control racks are held in the full-fuel position. Tighten the spring attaching bolts to 7-9 lb-ft (10-12 Nm) torque to retain the adjustment.

3. Set each power control device, while holding the injector control racks in the full-fuel position, by turning the adjusting screw down (clockwise) until it just touches the spring and the lock nut is tight against the plate. Then release the injector control racks.

> **NOTE:** Wipe the oil from each spring and the bottom of each adjusting screw so the point of contact can be seen readily.

> **CAUTION:** Steps 2 and 3 must be completed on both cylinder banks before proceeding with Step 4.

4. Start the engine. Then, with the engine running at full governed speed, check the horsepower. If necessary, re-adjust the screws to obtain the specified horsepower. Turn the screws down to decrease the horsepower; turn the screws up to increase the horsepower. When the desired wheel horsepower is obtained, hold the screws from turning and tighten the lock nuts.

> **NOTE:** If a dynamometer is not available, back up the lock nuts the distance stamped on the plates. Then turn the screws and lock nuts down together until the lock nuts *bottom* on the plates. Hold the screws from turning and tighten the lock nuts.

THROTTLE DELAY MECHANISM

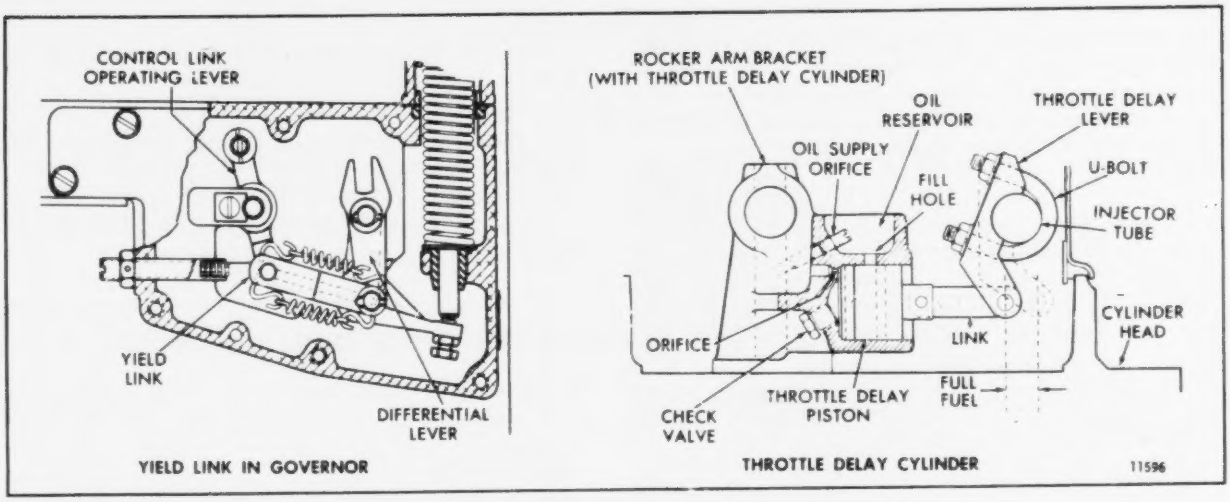

CONTROL LINK OPERATING LEVER
YIELD LINK
DIFFERENTIAL LEVER
YIELD LINK IN GOVERNOR
ROCKER ARM BRACKET (WITH THROTTLE DELAY CYLINDER)
OIL RESERVOIR
THROTTLE DELAY LEVER
OIL SUPPLY ORIFICE
FILL HOLE
U-BOLT
INJECTOR TUBE
CYLINDER HEAD
ORIFICE
LINK
FULL FUEL
THROTTLE DELAY PISTON
CHECK VALVE
THROTTLE DELAY CYLINDER
11596

Fig. 3 - Throttle Delay Cylinder and Yield Link

The throttle delay mechanism is used to retard full-fuel injection when the engine is accelerated. This reduces exhaust smoke and also helps to improve fuel economy.

The throttle delay mechanism (Fig. 3) is installed between the No. 1 and No. 2 cylinders on the right-bank cylinder head. It consists of a special rocker arm shaft bracket (which incorporates the throttle delay cylinder), a piston, throttle delay lever, connecting link, orifice plug, ball check valve and U-bolt.

A yield link replaces the standard operating lever connecting link in the governor.

Operation

Oil is supplied to a reservoir above the throttle delay cylinder through an orifice plug in the drilled oil passage in the rocker arm shaft bracket (Fig. 3). As the injector racks are moved toward the no-fuel position, free movement of the throttle delay piston is assured by air drawn into the cylinder through the ball check valve. Further movement of the piston uncovers an opening which permits oil from the reservoir to enter the cylinder and displace the air. When the engine is accelerated, movement of the injector racks toward the full-fuel position is momentarily retarded while the piston expels the oil from the cylinder through an orifice. To permit full accelerator travel, regardless of the retarded injector rack position, a spring loaded yield link replaces the standard operating lever connecting link in the governor.

Inspection

When inspecting the throttle delay hydraulic cylinder it is important that the check valve be inspected for wear. Replace the check valve if necessary.

To inspect the check valve, fill the throttle delay cylinder with diesel fuel oil and watch for check valve leakage while moving the engine throttle from the idle position to the full fuel position.

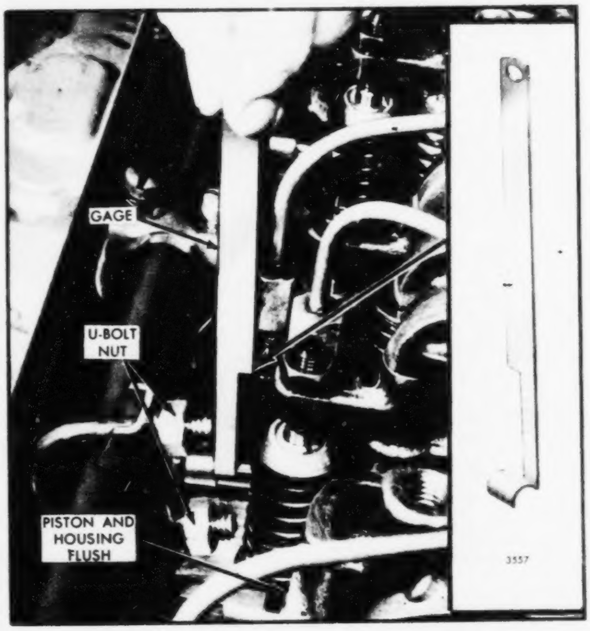

GAGE
U-BOLT NUT
PISTON AND HOUSING FLUSH
3557

Fig. 4 - Adjusting Throttle Delay Cylinder

Adjustment

Whenever the injector rack control levers are adjusted, disconnect the throttle delay mechanism by loosening the U-bolt which clamps the lever to the injector control tube. After the injector rack control levers have been positioned, the throttle delay mechanism must be re-adjusted. With the engine stopped, proceed as follows:

1. Refer to Fig. 4 and insert gage J 23190 (.454″ setting) between the injector body and the shoulder on the injector rack. Then exert a light pressure on the injector control tube in the direction of full fuel.

2. Align the throttle delay piston so it is flush with the edge of the throttle delay cylinder.

3. Tighten the U-bolt on the injector control tube and remove the gage.

4. Move the injector rack from the no-fuel to the full-fuel position to make sure it does not bind.

ADJUSTMENT OF MECHANICAL GOVERNOR SHUTDOWN SOLENOID

When a governor shutdown solenoid is used on an engine equipped with a mechanical governor, the governor stop lever must be properly adjusted to match the shutdown solenoid plunger travel.

The solenoid plunger can be properly aligned to the governor stop lever as follows:

1. Remove the bolt connecting the rod end eye (variable speed governor) or the right angle clip (limiting speed governor) to the stop lever (Figs. 5 and 6). Align and clamp the lever to the shutdown shaft in such a way that, at its mid-travel position, it is perpendicular to the solenoid plunger. This assures that the linkage will travel as straight as possible. The solenoid plunger has available 1/2″ travel which is more than adequate to move the injector control racks from the full-fuel to the complete no-fuel position and shutdown will occur prior to attaining complete travel.

2. With the stop lever in the *run* position, adjust the rod end eye or right angle clip for minimum engagement on the solenoid plunger when the connecting bolt is installed. The oversize hole in the eye or clip will thereby permit the solenoid to start closing the air gap, with a resultant build-up of pull-in force prior to initiating stop lever movement.

3. The bolt through the rod end eye or the right angle clip should be locked to the stop lever and adjusted to a height that will permit the eye or clip to float vertically. The clearance above and below the eye or clip and the bolt head should be approximately 1/32″ minimum.

> **NOTE:** The lock nut can be either on top of or below the stop lever.

4. Move the lever to the *stop* position and observe the plunger for any possible bind. If necessary, loosen the mounting bolts and realign the solenoid to provide free plunger motion.

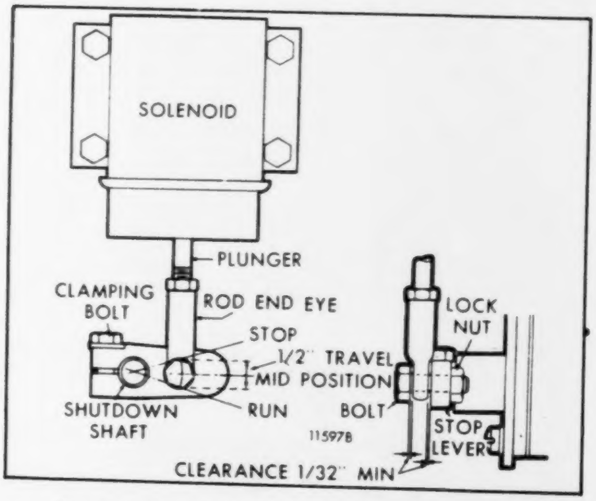


Fig. 5 - Typical Variable Speed Governor Lever Position

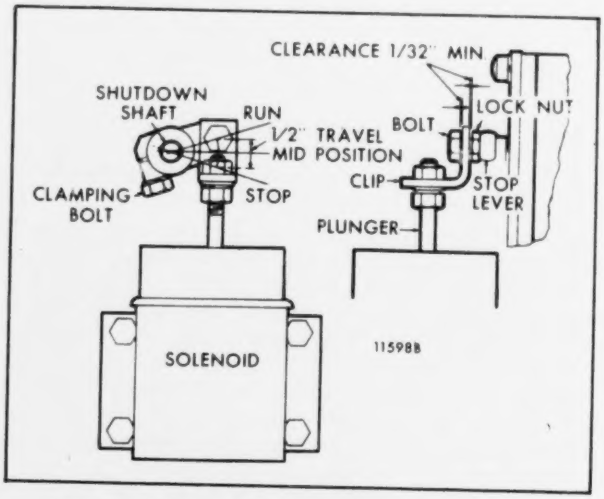


Fig. 6 - Typical Limiting Speed Governor Lever Position

VARIABLE SPEED HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6, 8 and 12V ENGINES

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor linkage (Fig. 1) and position the injector rack control levers.

Adjust Governor Linkage and Position Injector Rack Control Levers

1. Clean and remove the valve rocker cover from each cylinder head. Discard the gaskets.

2. Loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all of the control levers are free on the control tubes.

3. Disconnect the vertical link assembly from the governor operating lever and the bell crank.

4. Loosen the bolt and slide the governor operating lever from the serrated shaft.

5. Place the bolt (removed from the lower end of the vertical link) through the bell crank and into the recessed hole in the governor drive housing.

6. Adjust the No. 1R injector rack by turning the inner adjusting screw down until it bottoms on the control tube (Fig. 2). Turn down the outer adjusting screw until it also bottoms on the control tube. Then alternately tighten both the inner and outer adjusting screws.

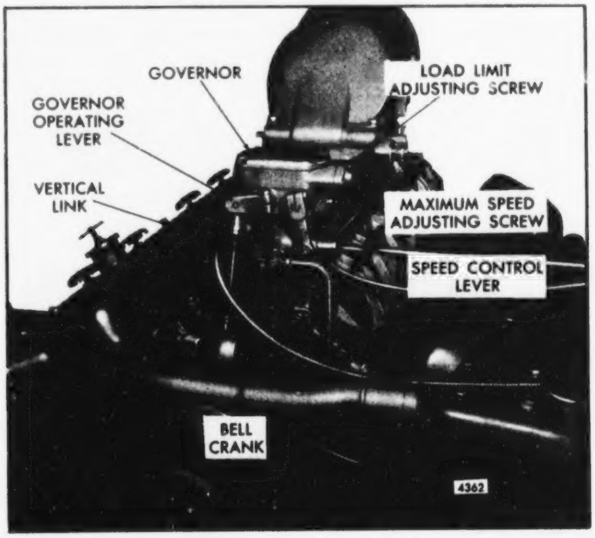

GOVERNOR
LOAD LIMIT ADJUSTING SCREW
GOVERNOR OPERATING LEVER
VERTICAL LINK
MAXIMUM SPEED ADJUSTING SCREW
SPEED CONTROL LEVER
BELL CRANK
4362

Fig. 1 - Hydraulic Governor Mounted on Engine

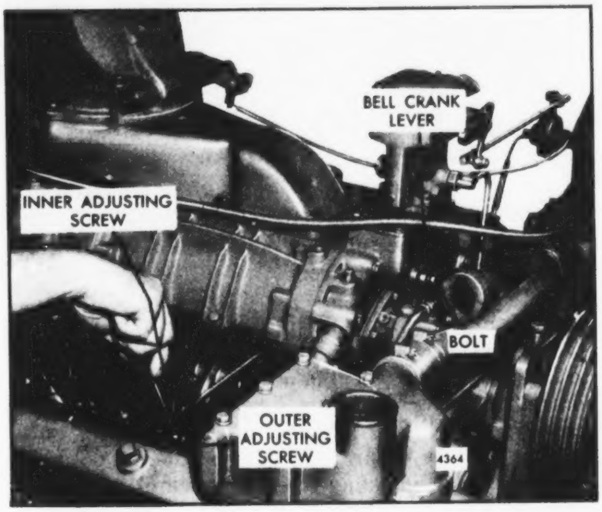

BELL CRANK LEVER
INNER ADJUSTING SCREW
BOLT
OUTER ADJUSTING SCREW
4364

Fig. 2 - Positioning No. 1R Rack Control Lever

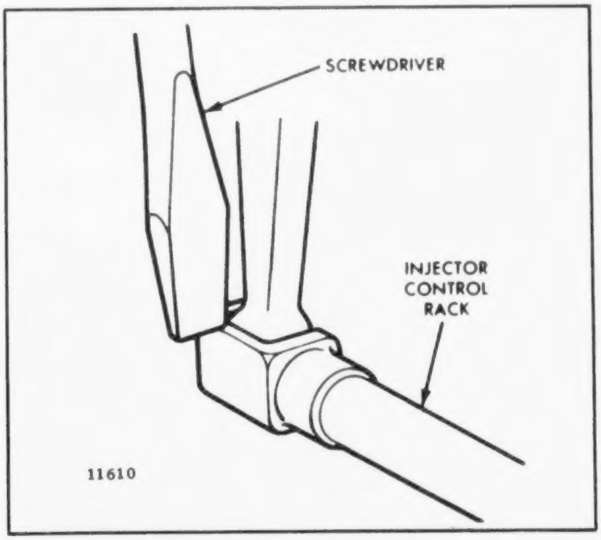

SCREWDRIVER
INJECTOR CONTROL RACK
11610

Fig. 3 - Checking Injector Rack "Spring"

CAUTION: Care should be taken to avoid setting the racks too tight and causing the fuel rod to bend.

7. To be sure the rack control lever is properly adjusted, press down on the injector rack with a screw driver or finger tip (Fig. 3). A light pressure should cause the rack to rotate. The rack is sufficiently tight if the rack returns or springs back to its original position when the pressure is removed. The rack is too tight if a heavy pressure is required to rotate the rack.

8. Adjust the No. 1L injector rack control lever as outlined in Steps 6 and 7.

9. Check the adjustment on the 1R and 1L injector rack control levers. If the setting is correct, the injector racks will be in the full-fuel position and snug on the ball end of the control levers.

10. To adjust the remaining injector rack control levers, hold the No. 1L injector rack in the full-fuel position by means of the lever on the end of the control tube assembly. Turn down the inner adjusting screw of the No. 2L injector rack control lever until the injector rack has moved into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

NOTE: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

11. Recheck the No. 1L injector rack to be sure that it has remained snug on the ball end of the injector rack control lever while positioning the No. 2L injector rack. If the rack of the No. 1L injector has become loose, back off the inner adjusting screw slightly on the No. 2L injector rack control lever. Tighten the outer adjusting screw. When the settings are correct, both injector racks must respond in the same manner on the ball end of their respective rack control levers as previously outlined in Step 7.

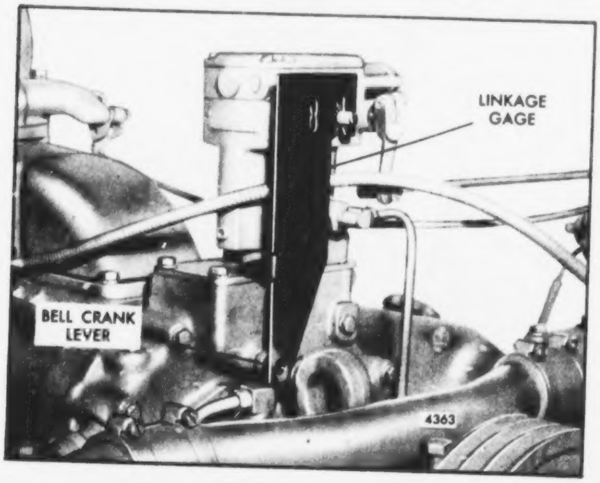


Fig. 4 - Linkage Gage in Position

12. Position the remaining injector rack control levers on the left and right cylinder heads as outlined in Steps 10 and 11. When the settings are correct, all of the injector racks will be snug on the ball end of the control levers when the injector control tube lever is held in the full-fuel position.

13. Remove the bolt from the recessed hole in the drive housing and install linkage gage J 21304 (Fig. 4).

14. Replace the governor operating lever on the serrated shaft so that the bolt hole is lined up within the proper lines on the gage (Fig. 5). The type of governor (SGX or PSG) will determine the proper position of the lever.

15. Remove the gage.

16. Move the bell crank lever to the no-fuel position.

17. Adjust the length of the vertical link so that the bolt holes of the levers and the centers of the rod end bearings are lined up (Fig. 6).

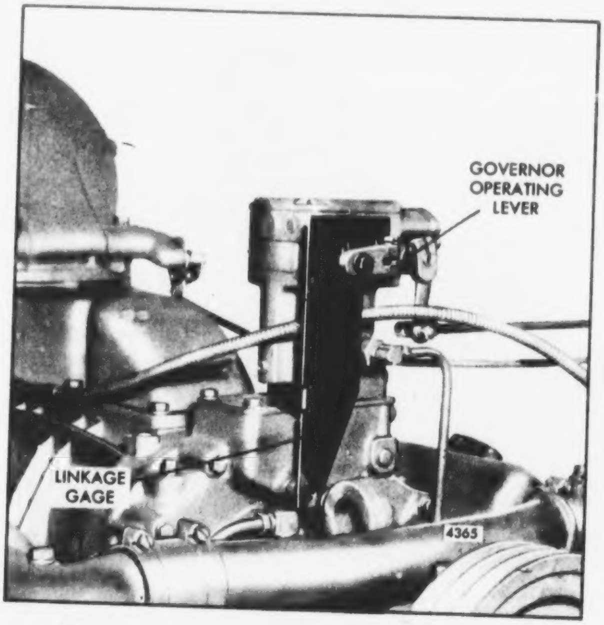


Fig. 5 - Governor Operating Lever in Position

18. Replace the two bolts in the levers and tighten the bolts.

19. Remove the governor cover.

20. With the load limit screw backed all the way out, retain the governor operating lever in the full-fuel position. The governor terminal lever should touch the boss in the governor housing (Fig. 7). Adjust the vertical link so that all of the injector racks are in the full-fuel position, then tighten the rod end lock nuts securely.

21. Use a new gasket and install a valve rocker cover on each cylinder head.

Adjust Load Limit

The load limit is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs or the injector rack control levers have been re-positioned, the load limit screw should be re-adjusted.

With the injector rack control levers properly adjusted, set the load limit as follows:

1. With the governor cover off and the load limit screw lock nut loosened, adjust the screw to obtain a distance of approximately 2" from the outside face of the boss on the governor sub-cap to the end of the screw. Then place and retain the governor operating lever in the full-fuel position as shown in Fig. 7.

CAUTION: Do not overstress the linkage.

2. Turn the load limit adjusting screw until a .020" space exists between the fuel rod collar and the terminal lever. If the adjustment cannot be made with a feeler gage, turn the load limit adjusting screw (with the lock nut tight enough to eliminate slack in the threads) inward until the injector racks just loosen on the ball end of the control levers.

3. Release the governor operating lever and hold the adjusting screw while tightening the lock nut. Then install the governor cover and tighten the screws.

Compensation Needle Valve Adjustment (PSG Governor)

Start the engine and, after the engine reaches normal operating temperature, adjust the governor compensation needle valve (without load on the engine) as follows:

1. Open the compensation needle valve (Fig. 11) two or three turns and allow the engine to "hunt" or "surge" for about one-half minute to bleed any air which may be trapped in the governor oil passages.

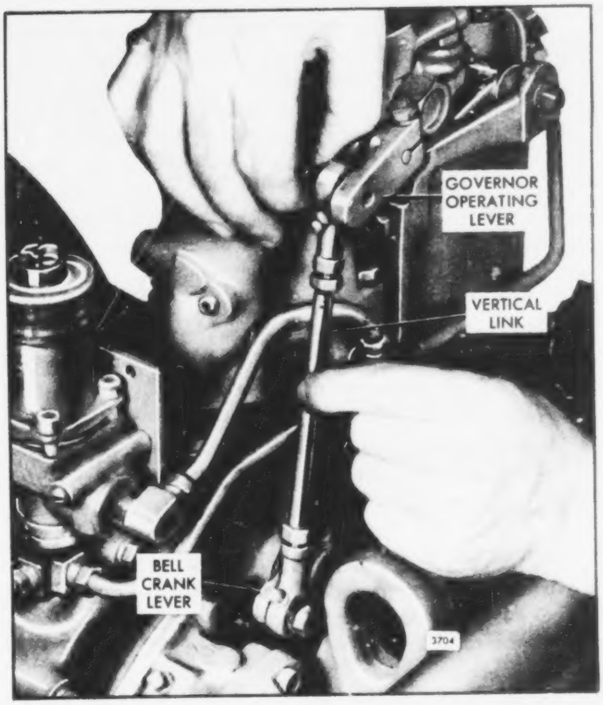


Fig. 6 - Adjusting Vertical Link

2. Gradually close the valve until the "hunting" just stops. Check the amount of valve opening by closing the valve completely and noting the number of turns

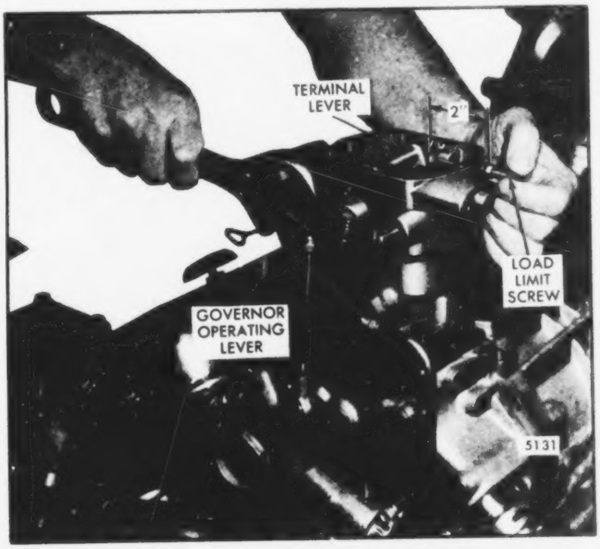


Fig. 7 - Adjusting Load Limit Screw

required to close it. Open the valve to the previously determined position at which the "hunting" stopped. Test the action of the governor by manually disturbing the engine speed. The engine should return promptly to the original steady speed with only a small overshoot. The correct valve setting will be between 1/8 and 1/2 turn open. Closing the valve farther than necessary will make the governor slow in returning the engine to normal speed after a load change.

Adjust Governor Speed Droop

INTERNAL DROOP ADJUSTMENT

The purpose of adjusting the speed droop is to establish a definite engine speed at no-load with a given speed at rated full-load.

The governor speed droop is set at the factory and further adjustment should be unnecessary. However, if the governor has been overhauled, the speed droop must be readjusted.

The best method of determining the engine speed is by using an accurate tachometer.

If a full rated load can be established on the unit, and the fuel rods, injector rack control levers and the load limit have been adjusted, set the speed droop as follows:

1. Start the engine and run it at approximately one-half the rated no-load speed until the lubricating oil temperature stabilizes.

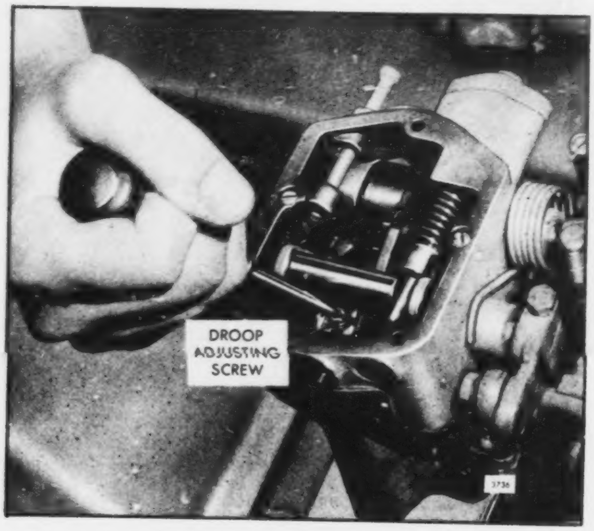


Fig. 8 - Adjusting Speed Droop

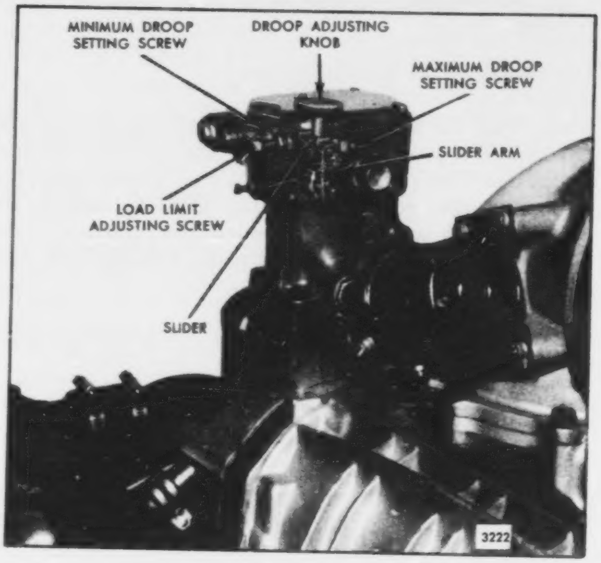

MINIMUM DROOP SETTING SCREW
DROOP ADJUSTING KNOB
MAXIMUM DROOP SETTING SCREW
SLIDER ARM
LOAD LIMIT ADJUSTING SCREW
SLIDER
3222

Fig. 9 - External Droop Control on PSG Isochronous Governor

> **NOTE:** When the engine lubricating oil is cold, the governor regulation may be erratic. Regulation will become increasingly stable as the temperature of the oil increases.

2. Stop the engine and remove the governor cover.

3. Loosen the lock nut and back off the maximum speed adjusting screw approximately 5/8".

4. Loosen the droop adjusting screw. Move the droop bracket so that the screw is midway between the ends of the slot in the bracket. Tighten the screw (Fig. 8).

5. With the throttle in the RUN position, adjust the engine speed until the engine is operating at 3% to 5% above the recommended full-load speed.

6. Apply the full rated load on the engine and readjust the engine speed to the correct full-load speed.

7. Remove the rated load and note the engine speed

Full Load	No Load
50 cycles, 1000 rpm	52.5 cycles, 1050 rpm
60 cycles, 1200 rpm	62.5 cycles, 1250 rpm
50 cycles, 1500 rpm	52.5 cycles, 1575 rpm
60 cycles, 1800 rpm	62.5 cycles, 1875 rpm

TABLE 1

after the speed stabilizes under no-load. If the speed droop is correct, the engine speed will be approximately 3% to 5% higher than the full-load speed.

If the speed droop is too high, stop the engine, loosen the droop adjusting screw and move the adjusting bracket IN toward the center of the governor. Tighten the screw. To increase the speed droop, move the bracket OUT, away from the center of the governor.

The speed droop in governors which control engines driving generators in parallel must be identical, otherwise the electrical load will not be equally divided.

Adjust the speed droop bracket in each governor to obtain the desired variation between engine no-load and full-load speeds. The recommended speed droop for generator sets operating in parallel is 50 rpm (2-1/2 cycles) for units operating at 1,000 and 1,200 rpm, and 75 rpm (2-1/2 cycles) for units operating at 1,500 and 1,800 rpm (Table 1). However, this speed droop recommendation may be varied to suit the individual application.

EXTERNAL DROOP CONTROL

Some PSG type governors are equipped with an external adjustable droop control (Fig. 9). This permits the speed droop to be adjusted without removing the governor cover. With this feature, a unit can be paralleled with another unit that is operating at constant frequency (zero droop). The incoming unit must have its droop bracket set in the maximum position while it is being paralleled and while operating in parallel. When it is desired to stop the unit operating at constant frequency, shift the load to the incoming unit and move the governor droop bracket to zero droop. Then adjust the outgoing unit to maximum droop, remove it from the line and stop the engine. The incoming unit will now be carrying the load and operating at constant frequency (zero droop).

Adjust the governor speed droop as follows:

1. Start the engine and run it at approximately one-half of the rated full-load speed until the lubricating oil temperature stabilizes.

2. Remove the load from the engine.

3. Back off the compensation needle valve to release any air that may be trapped in the system. Turn the needle valve in slowly to reduce governor "hunting". The correct needle valve setting will be between 1/8 and 1/2 turn open.

4. Back out the minimum and maximum droop setting screws.

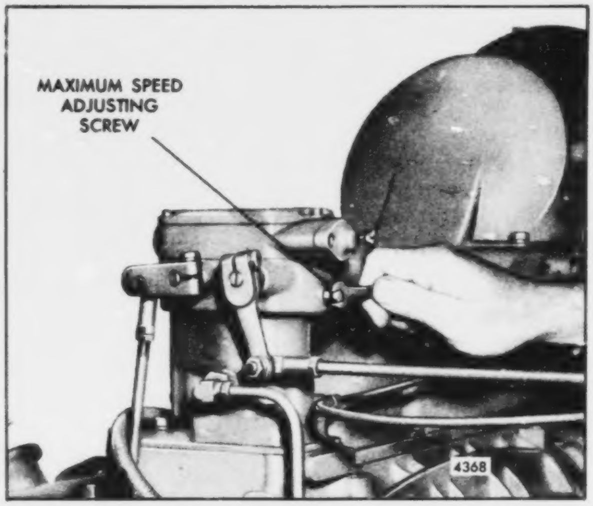


Fig. 10 - Adjusting Maximum No-Load Engine Speed

5. Loosen the droop adjusting knob and move the slider all the way in toward the center of the governor. Then tighten the knob.

6. Loosen the lock nut on the maximum speed adjusting screw (Fig. 10) and turn the screw out until 5/8" of the threads are exposed.

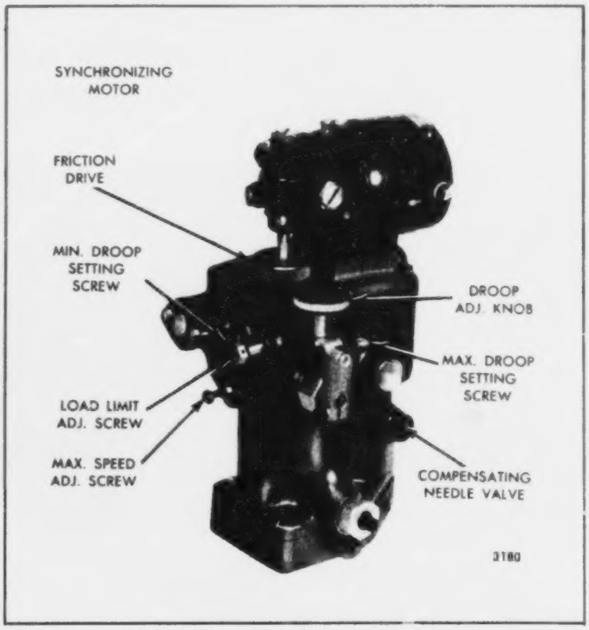


Fig. 11 - Typical Synchronizing Motor Mounting

7. With the engine operating at the recommended full-load speed, apply the full rated load and recheck the engine speed. If required, readjust the engine to full-load speed.

8. Remove the load and note the engine speed. If the zero droop setting is correct, the engine speed will remain constant. If the engine speed is higher, loosen the droop adjusting knob and set the slider to a reduced droop position.

9. When the desired minimum droop setting is reached, loosen the lock nut and turn the minimum droop setting screw inward until it contacts the droop linkage within the governor. This will be felt by a step-up of resistance while turning the adjusting screw. Lock the adjusting screw in this position.

10. Loosen the droop adjusting knob and slide the droop bracket in a direction to increase the droop. Perform Steps 7 and 8 to check the droop until the desired maximum speed droop is attained.

11. When the desired maximum droop setting is reached, loosen the lock nut and turn the maximum droop setting screw inward until it contacts the droop slider arm. Lock the adjusting screw in this position.

12. Recheck the minimum and maximum droop setting as outlined in Steps 7 and 8 and adjust the adjustment screws, if necessary, until the correct settings are obtained.

Adjust Maximum No-Load Speed

With the speed droop properly adjusted, set the maximum no-load speed as follows:

1. With the engine operating at no load, adjust the speed until the engine is operating at approximately 8% higher than the rated full-load speed.

2. Turn the maximum speed adjusting screw (Fig. 10) in until the screw contacts the throttle linkage internally, limiting the maximum speed of the engine at 8% above the rated full-load speed.

3. Hold the screw and tighten the lock nut.

Governors with Synchronizing Motor

Some hydraulic governors are equipped with a reversible electric synchronizing motor (Fig. 11) mounted on the governor cover.

The adjustments on a governor equipped with a synchronizing motor are the same as on a governor without the motor. However, the governor cover and motor assembly must be removed when setting the engine speed droop (except on a governor equipped with an external droop adjustment). The cover and motor must be reinstalled to check the speed droop.

VARIABLE SPEED HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

16V-71 ENGINE

The governor on the 16V engine is mounted on and driven from the front end of the rear blower (Fig. 1). The governor-to-injector control tube linkage is shown in Fig. 2.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor linkage and position the injector rack control levers.

Adjust Governor Linkage and Position Injector Rack Control Levers

1. Clean and remove the valve rocker cover from each cylinder head. Discard the gaskets.

2. Loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all of the control levers are free on the control tubes.

3. Remove the vertical link assembly from the governor operating lever and the bell crank lever.

4. Loosen the bolt and slide the governor operating lever from the serrated shaft.

5. Place the bolt (removed from the lower end of the vertical link) through the bell crank and into the recessed hole in the governor drive housing (Fig. 3).

6. Adjust the No. 4R injector rack by turning the inner adjusting screw down until it bottoms on the control tube (Fig. 4). Turn down the outer adjusting screw until it also bottoms on the control tube. Then tighten both the inner and outer adjusting screws alternately.

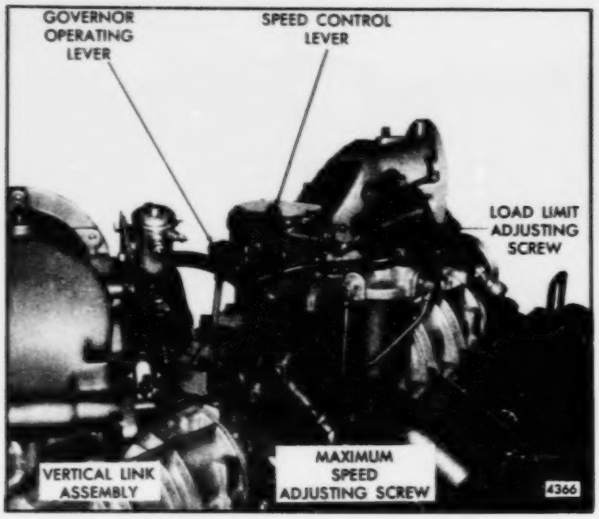

GOVERNOR OPERATING LEVER
SPEED CONTROL LEVER
LOAD LIMIT ADJUSTING SCREW
VERTICAL LINK ASSEMBLY
MAXIMUM SPEED ADJUSTING SCREW
4366

Fig. 1 - Hydraulic Governor Mounting

CAUTION: Care should be taken to avoid setting the racks too tight, causing the fuel rod to bend.

7. To be sure the rack control lever is properly adjusted, press down on the injector rack with a screw driver or finger tip (Fig. 5). A light pressure should cause the rack to rotate. The rack is sufficiently tight if the rack returns to its original position when the pressure is removed. The rack is too tight if a heavy pressure is required to rotate the rack.

8. Adjust the 5R, 4L and 5L injector rack control levers as outlined in Steps 6 and 7. When the settings are correct, all four of the injector racks will be snug on the ball end of the control levers when the injectors are in the full-fuel position.

9. To adjust the remaining injector rack control levers on the right front bank, hold the 4R injector rack in the full-fuel position by means of the lever on the control tube assembly and turn down the inner adjusting screw of the 3R injector rack control lever until the injector rack has moved into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

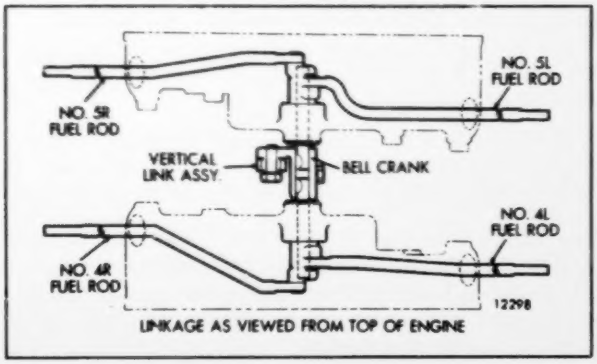

NO. 5L FUEL ROD
NO. 5R FUEL ROD
VERTICAL LINK ASSY.
BELL CRANK
NO. 4L FUEL ROD
NO. 4R FUEL ROD
12298
LINKAGE AS VIEWED FROM TOP OF ENGINE

Fig. 2 - Governor to Injector Rack Control Linkage

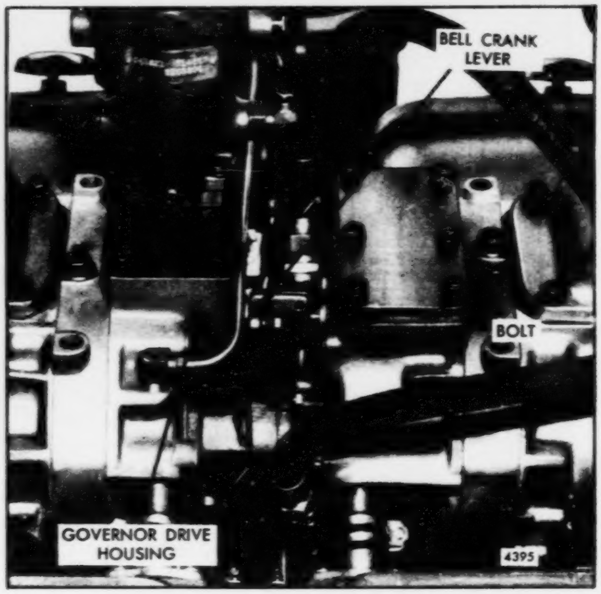

BELL CRANK LEVER
BOLT
GOVERNOR DRIVE HOUSING
4395

Fig. 3 - Bolt in Position through Bell Crank Lever

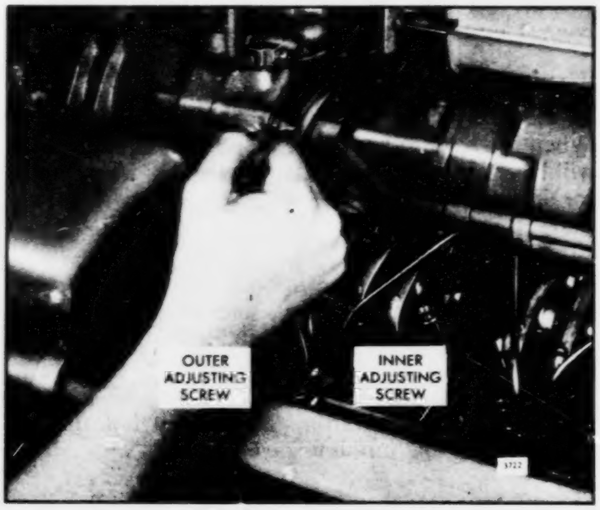

OUTER ADJUSTING SCREW
INNER ADJUSTING SCREW

Fig. 4 - Positioning No. 4R Injector Rack Control Lever

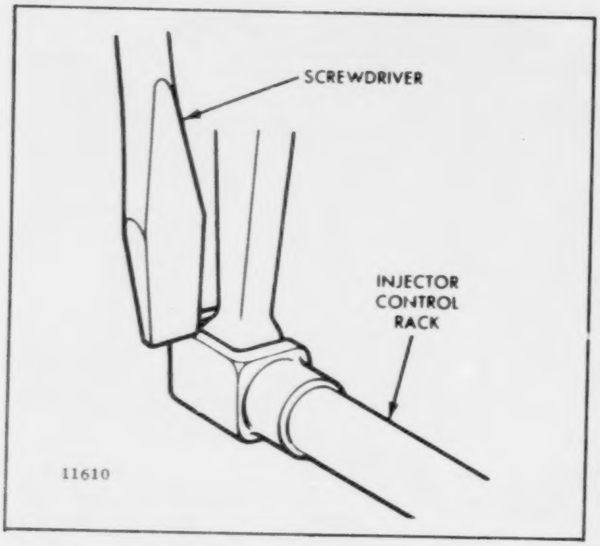


Fig. 5 - Checking Injector Rack "Spring"

NOTE: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

10. Recheck the No. 4R injector rack to be sure that it has remained snug on the ball end of the injector rack control lever. If the rack of No. 4R injector has become loose, back off the inner adjusting screw slightly on the 3R injector rack control lever. Tighten the outer adjusting screw. When the settings are correct, both injector racks must respond in the same manner on the ball ends of their respective rack control levers as previously outlined in Step 7.

11. Position the remaining injector rack control levers on the right front cylinder head as outlined in Step 9. When the settings are correct, all of the injector racks will be snug on the ball end of the control levers when the injector control tube lever is held in the full-fuel position.

12. Adjust the remaining injector rack control levers on the right rear, left front, and left rear cylinder heads in the same manner as outlined in Steps 9, 10 and 11.

13. Remove the bolt from the recessed hole in the drive housing and install linkage gage J 21304.

14. Replace the governor operating lever on the serrated shaft so that the bolt hole is lined up within the proper lines on the gage. The type of governor (SGX or PSG) will determine the proper position of the lever (Fig. 6).

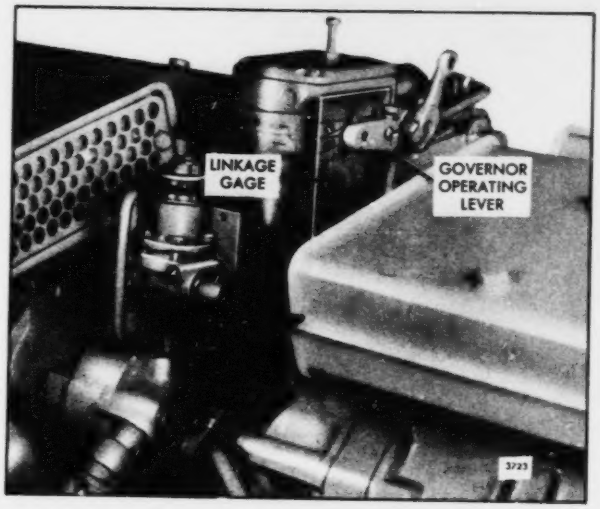


Fig. 6 - Governor Operating Lever in Position

15. Remove the gage.

16. Move the bell crank lever to the no-fuel position.

17. Adjust the length of the vertical link so that the bolt holes of the levers and the centers of the rod end bearings are lined up (Fig. 7).

18. Replace the two bolts in the levers and tighten the bolts.

19. Remove the governor cover.

20. With the load limit screw backed all the way out, retain the governor operating lever in the full-fuel position. The governor terminal lever should touch the boss on the governor housing. Adjust the vertical link so that all of the injector racks are in the full-fuel position, then tighten the rod end lock nuts securely.

21. Use a new gasket and install the valve rocker cover on each cylinder head.

Adjust Load Limit

The load limit is set at the factory and any further adjustment should be unnecessary. However, if the governor has had major repairs, or the injector control rack levers have been re-positioned the load limit screw should be re-adjusted.

With the injector rack control levers properly adjusted, set the load limit as follows:

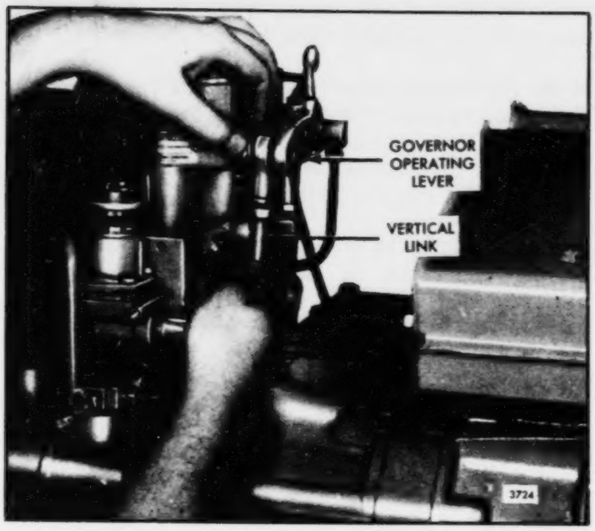


Fig. 7 – Adjusting Vertical Link

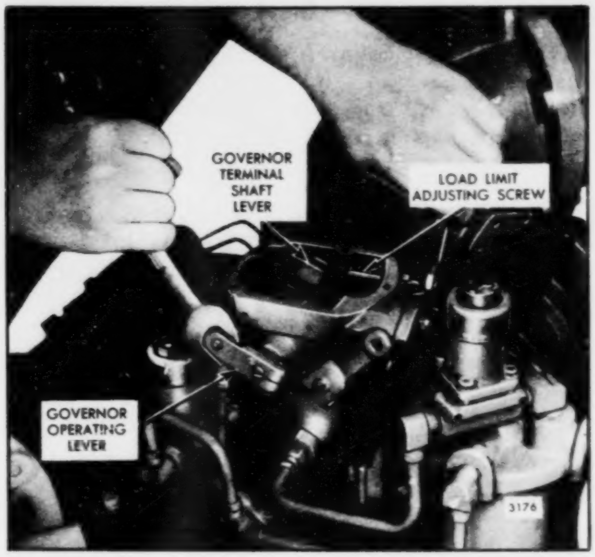


Fig. 8 – Adjusting Load Limit Screw

1. With the governor cover off and the load limit screw lock nut loosened, place and retain the governor operating lever in the full-fuel position as shown in Fig. 8.

CAUTION: Do not overstress the linkage.

2. Turn the load limit adjusting screw until a .020" space exists between the fuel rod collar and the terminal lever. If the adjustment cannot be made with a feeler gage, turn the load limit adjusting screw (with the lock nut tight enough to eliminate any slack in the threads) in until the injector racks just loosen on the ball end of the control levers.

3. Release the governor operating lever and hold the adjusting screw while tightening the lock nut. Then install the governor cover and tighten the screws.

Compensation Needle Valve Adjustment (PSG Governor)

Start the engine and, after the engine reaches normal operating temperature, adjust the governor compensation needle valve, without load on the engine, as follows:

1. Open the valve (Fig. 10) two or three turns and allow the engine to "hunt" or "surge" for about one-half minute to bleed any air which may be trapped in the governor oil passages.

2. Gradually close the valve until the "hunting" just stops. Check the amount of valve opening by closing the valve completely and noting the number of turns required to close it. Open the valve to the previously determined position at which the "hunting" stopped. Test the action of the governor by manually disturbing the engine speed. The engine should return promptly to the original steady speed with only a small overshoot. The correct valve setting will be between 1/8 and 1/2 turn open. Closing the valve farther than necessary will make the governor slow in returning the engine to normal speed after a load change.

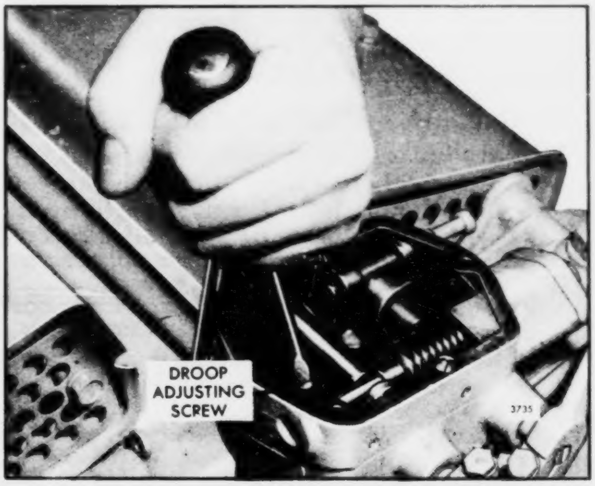


Fig. 9 – Adjusting Speed Droop

Adjust Governor Speed Droop

INTERNAL DROOP ADJUSTMENT

The purpose of adjusting the speed droop is to establish a definite speed at no-load with a given speed at rated full-load.

The governor speed droop is set at the factory and further adjustment should be unnecessary. However, if the governor has been overhauled, the speed droop must be readjusted.

The best method of determining the engine speed is by using an accurate hand tachometer.

If a full rated load can be established on the unit, and the fuel rods, injector rack control levers and the load limit have been adjusted, set the speed droop as follows:

1. Start the engine and run it at approximately one-half the rated no-load speed until the lubricating oil temperature stabilizes.

> **NOTE:** When the engine lubricating oil is cold, the governor regulation may be erratic. Regulation will become increasingly stable as the temperature of the oil increases.

2. Stop the engine and remove the governor cover.

3. Loosen the lock nut and back off the maximum speed adjusting screw approximately 5/8".

4. Loosen the droop adjusting bolt on former units or the screw on current units (Fig. 9). Move the droop bracket so that the screw is midway between the ends of the slot in the bracket. Tighten the screw.

5. With the throttle in the RUN position, adjust the engine speed until the engine is operating at 3% to 5% above the recommended full-load speed.

6. Apply the full rated load on the engine and readjust the engine speed to the correct full-load speed.

7. Remove the rated load and note the engine speed after the speed stabilizes under no load. If the speed droop is correct, the engine speed will be approximately 3% to 5% higher than the full-load speed.

Full Load	No Load
50 cycles, 1000 rpm	52.5 cycles, 1050 rpm
60 cycles, 1200 rpm	62.5 cycles, 1250 rpm
50 cycles, 1500 rpm	52.5 cycles, 1575 rpm
60 cycles, 1800 rpm	62.5 cycles, 1875 rpm

TABLE 1

If the speed droop is too high, stop the engine, loosen the droop adjusting screw and move the adjusting bracket IN toward the center of the governor. Tighten the screw. To increase the speed droop, move the bracket OUT, away from the center of the governor.

The speed droop in governors which control engines driving generators in parallel must be identical, otherwise the electrical load will not be equally divided.

Adjust the speed droop bracket in each governor to obtain the desired variation between engine no-load and full-load speeds. The recommended speed droop for generator sets operating in parallel is 50 rpm (2-1/2 cycles) for units operating at 1,000 and 1,200 rpm, and 75 rpm (2-1/2 cycles) for units operating at 1,500 and 1,800 rpm (Table 1). However, this speed droop recommendation may be varied to suit the individual application.

EXTERNAL DROOP CONTROL

Some PSG type governors are equipped with an external adjustable droop control (Fig. 10). This permits the speed droop to be adjusted without removing the governor cover. With this feature, a unit can be paralleled with another unit that is operating at constant frequency (zero droop). The incoming unit must have its droop bracket set in the maximum position while it is being paralleled and while operating in parallel. When it is desired to stop the unit operating at constant frequency, shift the load to the incoming unit and move the governor droop bracket to zero droop. Then adjust the outgoing unit to maximum droop, remove it from the line and stop the engine. The incoming unit will now be carrying the load and operating at constant frequency (zero droop).

Adjust the governor speed droop as follows:

1. Start the engine and run it at approximately one-half of the rated full-load speed until the lubricating oil temperature stabilizes.

2. Remove the load from the engine.

3. Back off the compensation needle valve to release any air that may be trapped in the system. Turn the needle valve in slowly to reduce governor "hunting". The correct needle valve setting will be between 1/8 and 1/2 turn open.

4. Back out the minimum and maximum droop setting screws.

5. Loosen the droop adjusting knob (Fig. 10) and

move the slider all the way in toward the center of the governor. Then tighten the knob.

6. Loosen the lock nut on the maximum speed adjusting screw and turn the screw out until 5/8" of the threads are exposed.

7. With the engine operating at the recommended full-load speed, apply the full rated load and recheck the engine speed. If required, readjust the engine to full-load speed.

8. Remove the load and note the engine speed. If the zero droop setting is correct, the engine speed will remain constant. If the engine speed is higher, loosen the droop adjusting knob and set the slider to a reduced droop position.

9. When the desired minimum droop setting is reached, loosen the lock nut and turn the minimum droop setting screw in until it contacts the droop linkage within the governor. This will be felt by a step-up of resistance while turning the adjusting screw. Lock the adjusting screw in this position.

10. Loosen the droop adjusting knob and slide the droop bracket in a direction to increase the droop. Perform Steps 7 and 8 to check the droop until the desired maximum speed droop is attained.

11. When the desired maximum droop setting is reached, loosen the lock nut and turn the maximum droop setting screw in until it contacts the droop slider arm. Lock the adjusting screw in this position.

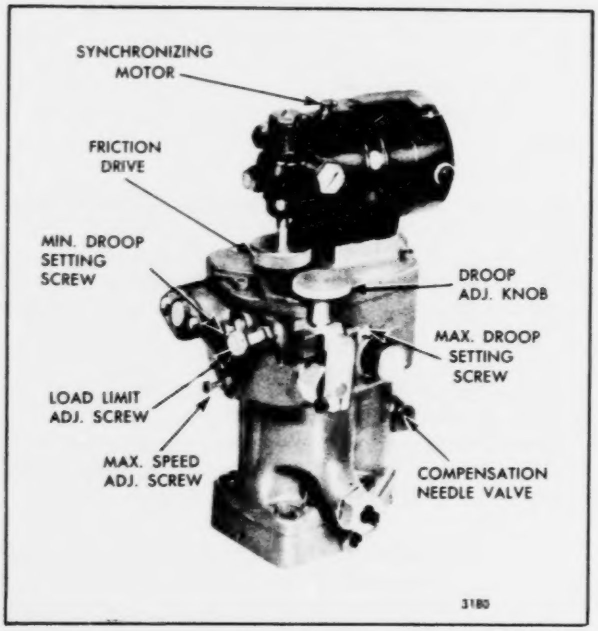


Fig. 10 - Typical Synchronizing Motor Mounting

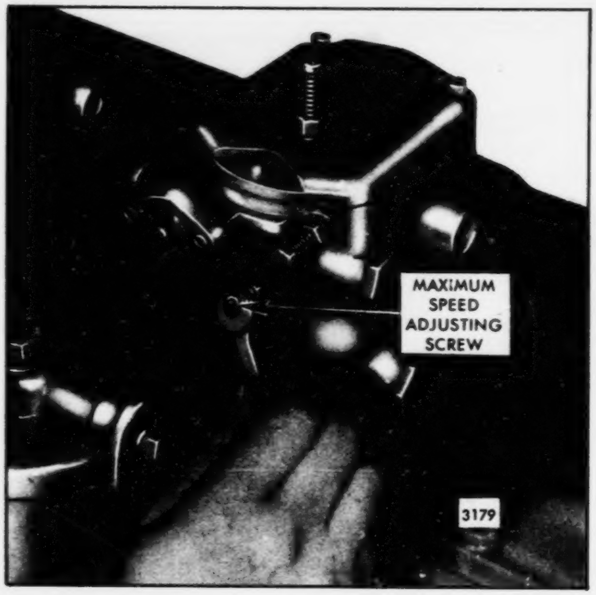


Fig. 11 - Adjusting Maximum No-Load Engine Speed

12. Recheck the minimum and maximum droop setting as outlined in Steps 7 and 8 and adjust the adjustment screws, if necessary, until the correct settings are obtained.

Adjust Maximum No-Load Speed

With the speed droop properly adjusted, set the maximum no-load speed as follows:

1. With the engine operating at no-load, adjust the speed until the engine is operating at approximately 8% higher than the rated full-load speed.

2. Turn the maximum speed adjusting screw (Fig. 11) in until the screw contacts the throttle linkage internally, limiting the maximum speed of the engine at 8% above the rated full-load speed.

3. Hold the screw and tighten the lock nut.

Adjust Low-Speed Stop Screw

The low-speed stop screw (Fig. 12) projects from the top of the governor cover. This screw is used to establish an idle speed setting when the throttle is moved to the **idle/neutral** position on marine units,

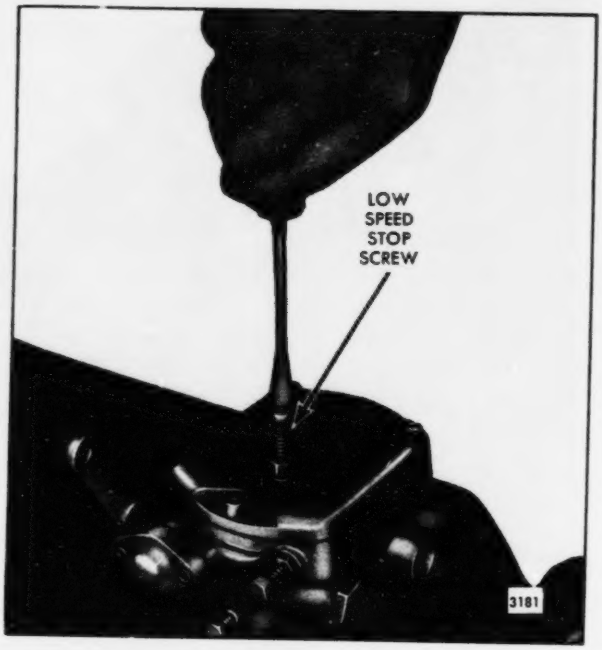


Fig. 12 - Adjusting Low-Speed Stop Screw

thus preventing false engine shutdowns. To establish the desired engine idle speed, proceed as follows:

1. Loosen the lock nut and back out the low speed stop screw.

2. Start the engine and carefully reduce the speed with the throttle until the desired idle speed is established.

3. Turn the low-speed stop screw down until the engine speed just begins to increase.

4. Tighten the lock nut to secure the stop screw in place.

NOTE: The marine engine is stopped when the solenoid in the oil dump line from the governor servo-piston is energized.

Governors with Synchronizing Motor

Some hydraulic governors are equipped with a reversible electric synchronizing motor (Fig. 10) mounted on the governor cover.

The adjustments on a governor equipped with a synchronizing motor are the same as on a governor without the motor. However, the governor cover and motor assembly must be removed when setting the engine speed droop (except on a governor equipped with the external droop adjustment). The cover and motor must be reinstalled to check the speed droop.

LIMITING SPEED HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

16V-71 ENGINE

The governor on the 16V engine is mounted on and driven from the front end of the rear blower (Fig. 1). The governor to injector rack control linkage is shown in Fig. 2.

The objectives of the tune-up are (1) to adjust the linkage so the injector racks will be at the full-fuel position when the terminal lever shaft pointer indicates exactly 18°, (2) to set the band-level so the governor will place the pointer at exactly 18° just below full-load speed and, (3) to adjust the speed droop, idle speed and maximum no-load speed.

Prior to starting the tune-up, remove the governor control housing cover and turn the buffer screw out until it clears the differential lever approximately 1/4 inch, when the speed control lever is in the idle position. Then hold the speed control lever in the maximum speed position and move the governor operating lever to check the travel of the terminal shaft lever as indicated by the pointer.

The pointer should move from 0° to 36° (on some governors, the pointer may not quite reach 36°). Next, check to be sure that the pointer is exactly at zero when the linkage is in the no-fuel position. If not, adjust the pointer or the terminal lever shaft position indicator plate (scale).

The pointer is attached to a metal ring which is secured to the terminal shaft by a set screw (Fig. 3). To make the zero adjustment, loosen the set screw and, with the linkage in the no-fuel position, set the pointer at exactly zero. Then tighten the set screw.

After the zero adjustment is completed, to make sure the shaft is assembled correctly, reach in behind the differential lever in the governor control housing and force the governor operating lever upward until the pointer is aligned exactly with the 18° mark (Fig. 6). The pointer should be vertical; if it is approximately 1/16" off vertical, the shaft is probably out one serration. To make the necessary correction, remove

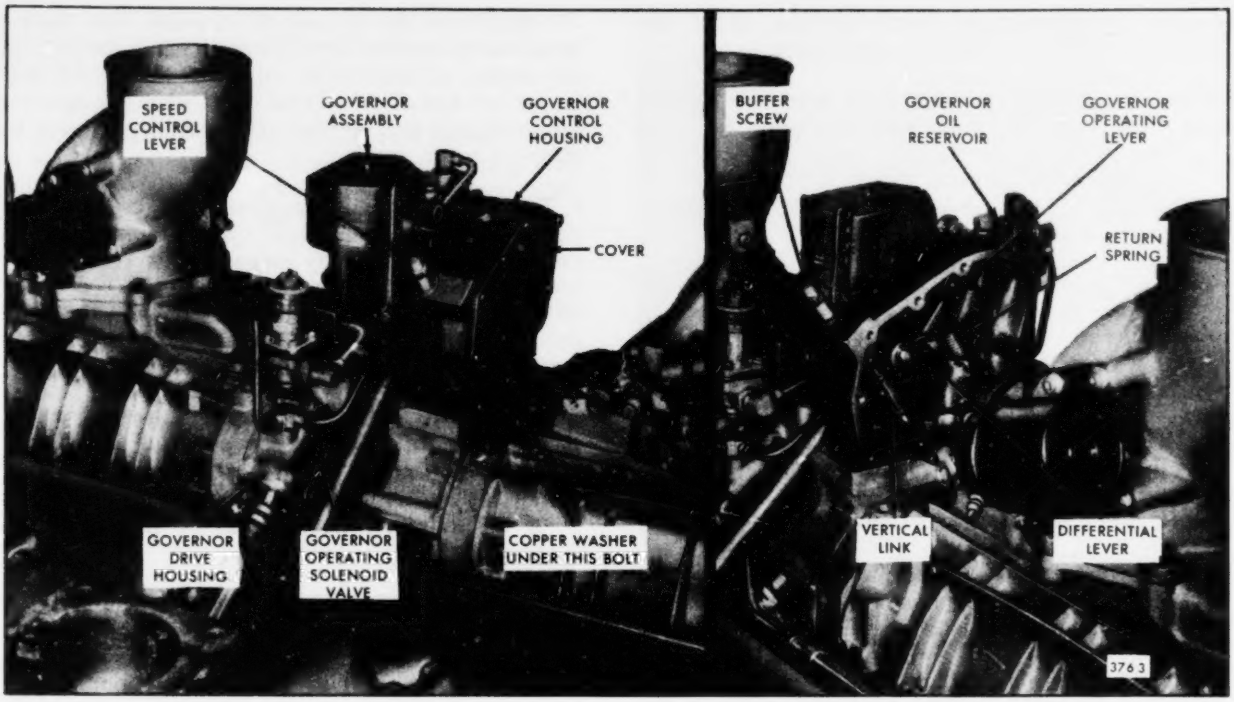

SPEED CONTROL LEVER
GOVERNOR ASSEMBLY
GOVERNOR CONTROL HOUSING
COVER
BUFFER SCREW
GOVERNOR OIL RESERVOIR
GOVERNOR OPERATING LEVER
RETURN SPRING
GOVERNOR DRIVE HOUSING
GOVERNOR OPERATING SOLENOID VALVE
COPPER WASHER UNDER THIS BOLT
VERTICAL LINK
DIFFERENTIAL LEVER
3763

Fig. 1 - Governor Mounting and Linkage in the Control Housing

the sub-cap (refer to *Adjust Maximum No-Load Speed*), then remove the cotter pin from the shaft and make a careful visual check of the alignment of the holes in the terminal lever and the shaft. If they are not in alignment, remove the shaft and reinstall it so the holes are in perfect alignment. Then install the cotter pin and sub-cap.

Then, after adjusting the exhaust valves and timing the injectors, position the injector rack control levers, adjust the governor linkage and adjust the governor.

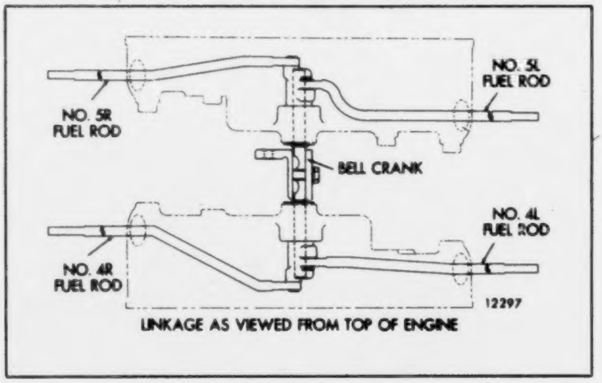

NO. 5L FUEL ROD
NO. 5R FUEL ROD
BELL CRANK
NO. 4L FUEL ROD
NO. 4R FUEL ROD
12297
LINKAGE AS VIEWED FROM TOP OF ENGINE

Fig. 2 - Governor-to-Injector Rack Control Linkage

Position Injector Rack Control Levers and Adjust Governor Linkage

1. Clean and remove the valve rocker cover from each cylinder head.

2. Loosen all of the inner and outer injector rack

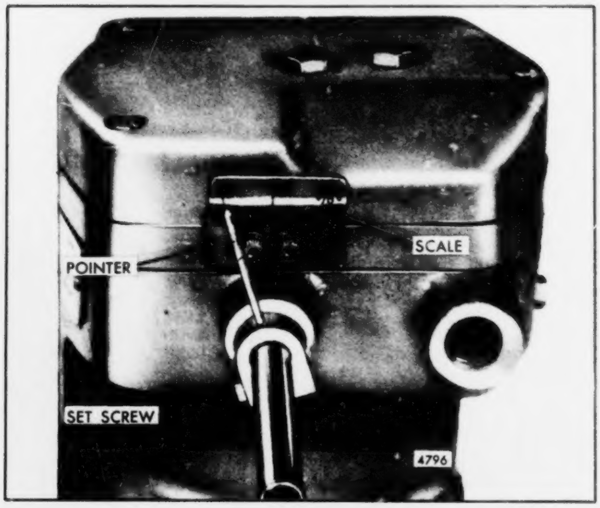

SCALE
POINTER
SET SCREW
4796

Fig. 3 - Governor Pointer and Scale

control lever adjusting screws. Be sure all of the control levers are free on the control tubes.

3. Disconnect the upper end of the adjustable vertical link (Fig. 1) from the differential lever pin.

> **CAUTION:** Stuff a clean rag in the opening to prevent the clip or washer from dropping into the engine.

4. Place linkage gage J 21351 in position so the pin in the gage enters the hole in the bell crank lever and the tangs on each side of the gage rest on top of the governor drive housing cover (Fig. 4). The gage holds the linkage in the full-fuel position while the injector racks are being adjusted.

5. Adjust the 4R injector rack by turning the inner adjusting screw down until a slight movement of the control tube is observed or a step-up in effort is noted (Fig. 5). This will place the rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms slightly on the control tube. Then alternately tighten both the inner and outer adjusting screws.

> **CAUTION:** If the injector rack is set too tight, it will cause the fuel rod to bend.

6. To be sure the injector rack control lever is properly adjusted, press down on the injector rack with a screw driver or finger tip. A light pressure should cause the rack to rotate. The rack is sufficiently tight if it returns to its original position when the pressure is removed. The rack is too tight if a heavy pressure is required to rotate it.

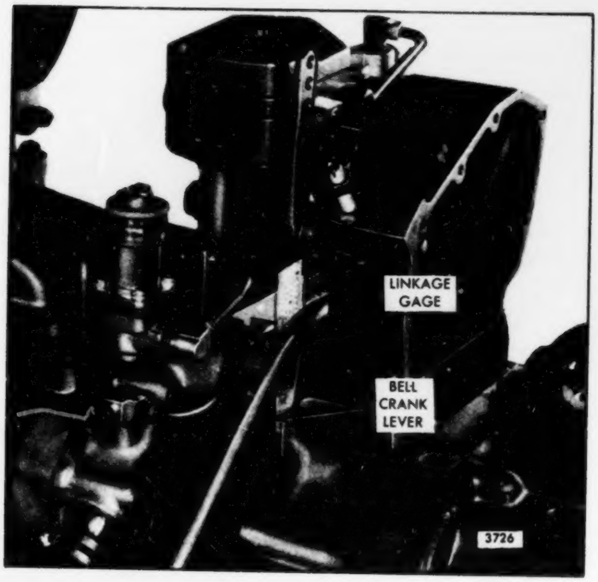


Fig. 4 - Linkage Gage in Position

7. Adjust the 5R, 4L and 5L injector rack control levers as outlined in Steps 5 and 6. When the settings are correct, all four of the injector racks will be snug on the ball end of the control levers when the injectors are in the full-fuel position. The linkage gage may be removed at this time.

8. To adjust the remaining injector rack control levers on the right front bank, hold the 4R injector rack in the full-fuel position, by means of the control tube lever, and turn down the inner adjusting screw of the 3R injector rack control lever until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

9. Recheck the 4R injector rack to be sure it has remained snug on the ball end of the injector rack control lever. If the 4R injector rack has become loose, back off the inner adjusting screw slightly on the 3R injector rack control lever and tighten the outer adjusting screw. When the settings are correct, both

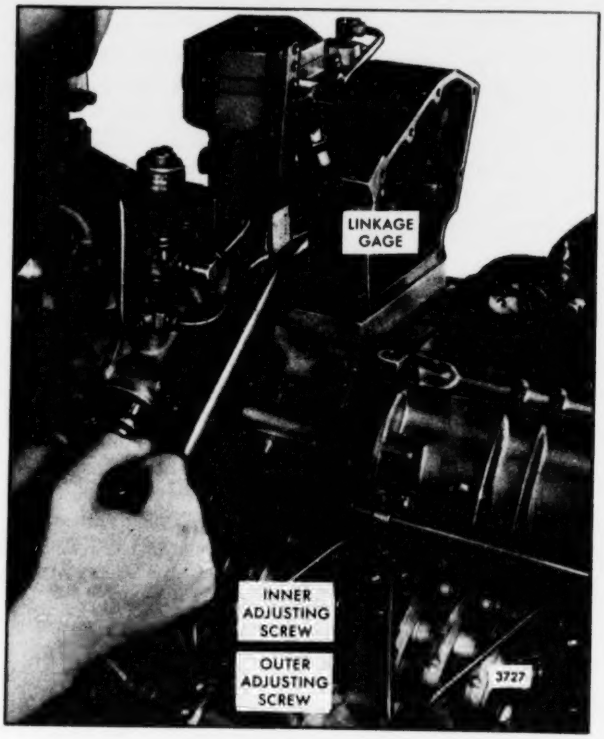


Fig. 5 - Positioning No. 4R Injector Rack Control Lever

injector racks must respond in the same manner on the ball ends of their respective rack control levers as in Step 6.

10. Position the remaining injector rack control levers on the right front cylinder head in the same manner. When the settings are correct, all of the injector racks will be snug on the ball end of the control levers when the injector control tube is in the full-fuel position.

11. Adjust the remaining injector rack control levers on the right rear, left front, and left rear cylinder heads in the same manner as in Steps 8, 9 and 10.

12. Reconnect the upper end of the adjustable vertical link on the differential lever pin and secure it in place with the washer and clip.

13. To be sure that the governor flyweights will be in the vertical position throughout the intermediate speed range (between idle speed and full-load speed), adjust the vertical link as follows.

a. Loosen and back off the two turnbuckle lock nuts two or three turns.

b. Secure the speed control lever in the maximum speed position.

c. Reach in behind the differential lever in the governor control housing and force the governor operating lever upward until the governor pointer is aligned exactly with the 18° mark (Fig. 6). Hold the lever in this position.

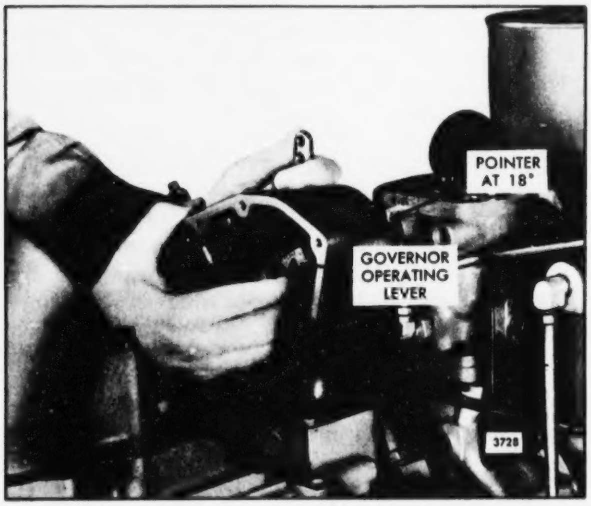


Fig. 6 - Moving Operating Lever

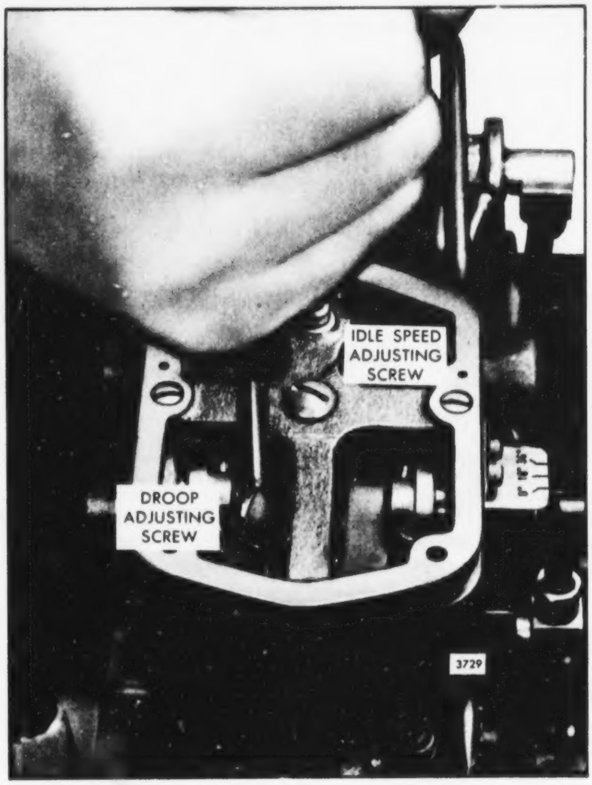


Fig. 7 - Adjusting Speed Droop

NOTE: It is very important that the force to move the pointer to 18° be applied to the governor operating lever rather than to the differential lever. This is necessary to ensure that the terminal lever pin is tight against the upper side of the slot in the differential lever just as it is when the engine is running under governor control.

d. Adjust the length of the vertical link, by means of the turnbuckle, so the injector racks are in the full-fuel position. Then tighten the lock nuts.

e. Recheck to determine if the pointer still points to exactly 18° when the injector racks are at the full-fuel position. Readjust the vertical link, if necessary.

f. Release the speed control lever. With the lever in the idle speed position, the pointer should be at approximately 18°.

14. Use a new gasket and install the valve rocker cover on each cylinder head.

Adjust Governor Speed Droop

1. Remove the governor cover.

2. Set the governor speed droop bracket at its mid-position (Fig. 7). After the other adjustments are made, the speed droop may be increased if the engine speed is unstable.

Preliminary Band-Level Adjustment

The band-level adjustment corresponds to the gap adjustment on a mechanical limiting speed governor. In the low idle speed range, the governor pointer will be between the 18° and 36° marks. As the speed is increased, by moving the speed control lever, the pointer will gradually approach 18° and should be exactly at 18° just below the full-load speed of the engine. After full load is reached, the pointer will move rather rapidly until at the no-load speed it will indicate a position approximately half way between the 18° and 0° marks.

If the pointer is above 18° just below the full-load speed of the engine, the band-level is too low; if the pointer is below 18°, the band-level is too high. Perform a preliminary band-level adjustment as follows:

1. Hold the linkage so the pointer indicates 18°.

2. With a long thin screw driver, pry one of the flyweights outward with a light force (Figs. 8 and 9). It should reach a vertical position. If not, proceed with Step 3.

> **NOTE:** The position of the flyweights determines the position of the pilot valve plunger, which controls the flow of oil to the servo piston. If the flyweights are too far in, the plunger will not close off the ports and oil will flow to the servo piston. This will cause the terminal lever to move the pointer beyond 18° and result in excessive speed when the engine is started. When the flyweights are too far out, the plunger moves up and dumps the oil from the servo piston. This causes the terminal lever to drop below the 18° position and will result in difficulty in starting the engine or in attaining speed.

3. Loosen the band-level pivot arm lock screw and turn the band-level adjusting nut (Figs. 8 and 10) clockwise to raise the band-level or counter-clockwise to lower the band-level. Tighten the lock screw to draw the pivot arm assembly in place. Then check the adjustment as described in Step 2. Readjust the band-level, if necessary.

> **CAUTION:** Turning the band-level adjusting nut does not in itself complete the adjustment. The lock screw must be tightened to draw the pivot arm assembly into the new position, especially if the nut was turned down.

Adjust Idle Speed

There should be approximately 1/16" clearance between the bottom of the idle speed adjusting screw head and the plunger directly under the screw head (Fig. 8).

1. Close the governor operating solenoid valve switch, if a normally open type valve is used.

2. Start the engine.

> **CAUTION:** Stop the engine if the speed starts to increase above idle speed while the speed control lever is in the idle position. Raise the band-level again until the speed remains at idle.

3. If the engine stalls with the speed control lever in the idle position, turn the idle screw down (clockwise) 1/4 turn or until the engine will continue running.

4. Hold the speed control lever in the idle position. Then turn the idle speed adjusting screw (Figs. 8 and 10) in or out until the desired idle speed is obtained.

Set Band-Level at 18°

1. Gradually move the speed control lever from the idle to maximum speed position and while doing this, observe the movement of the pointer and also record the top no-load speed. The normal movement of the pointer in response to the speed control lever travel should be as follows:

   a. During the first 100 or 200 rpm increase above idle speed, the pointer should move from approximately midway between 18° and 36° to slightly above 18°. Then, as the speed increases on up to approximately 300 rpm below the top no-load speed, the pointer should move slightly until it is exactly at 18°. From full-load speed up to no-load speed, the pointer should move from 18° to nearly midway between 18° and 0°.

   b. If the pointer indicates more than 18° at approximately 300 rpm below the top no-load speed, the band-level is too low. The adjusting nut should be turned clockwise, in small increments, until the pointer indicates exactly 18° at the above speed.

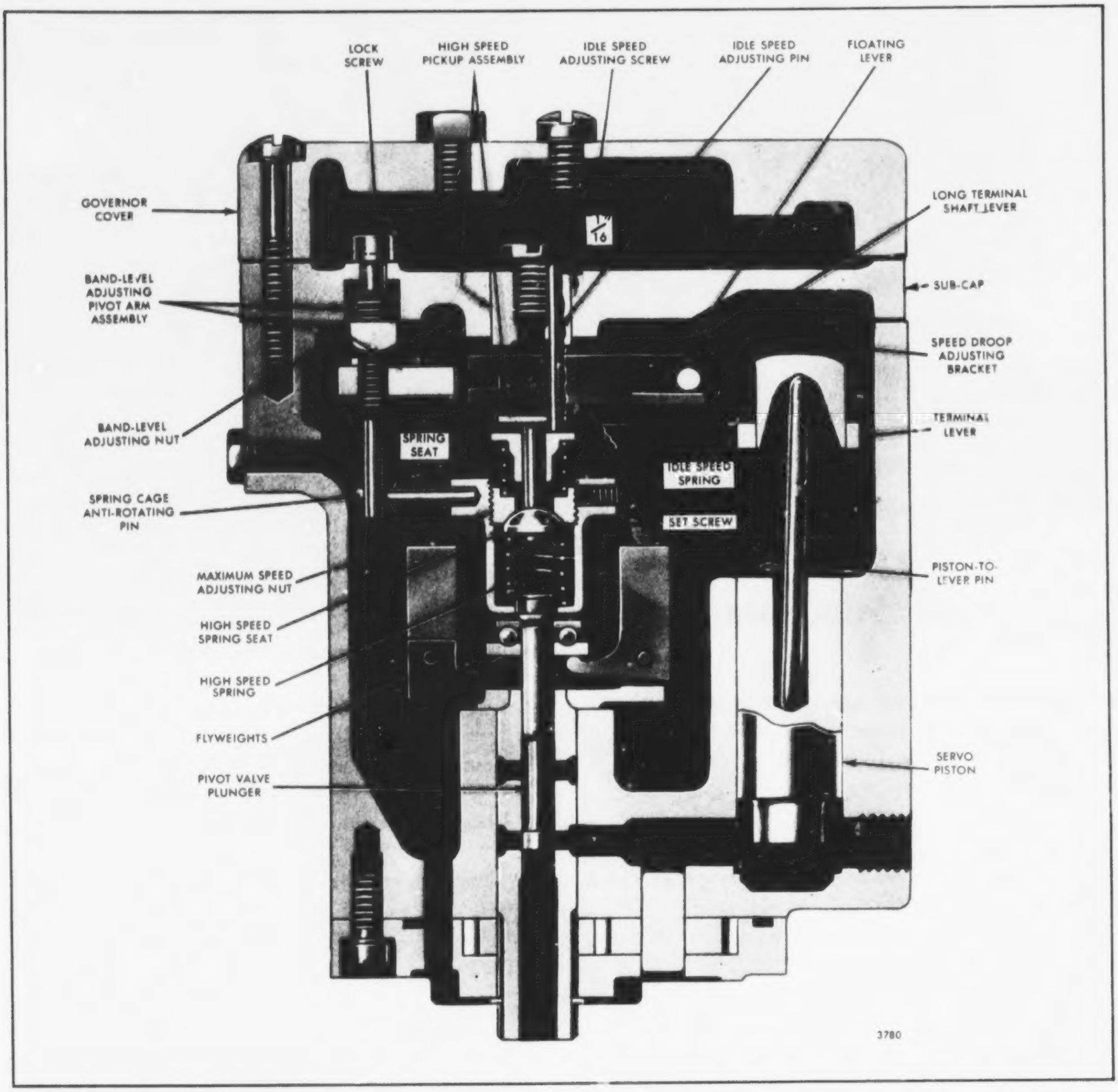

LOCK SCREW
HIGH SPEED PICKUP ASSEMBLY
IDLE SPEED ADJUSTING SCREW
IDLE SPEED ADJUSTING PIN
FLOATING LEVER
GOVERNOR COVER
1/16
LONG TERMINAL SHAFT LEVER
SUB-CAP
BAND-LEVEL ADJUSTING PIVOT ARM ASSEMBLY
SPEED DROOP ADJUSTING BRACKET
TERMINAL LEVER
BAND-LEVEL ADJUSTING NUT
SPRING SEAT
IDLE SPEED SPRING
SET SCREW
SPRING CAGE ANTI-ROTATING PIN
MAXIMUM SPEED ADJUSTING NUT
PISTON-TO-LEVER PIN
HIGH SPEED SPRING SEAT
HIGH SPEED SPRING
FLYWEIGHTS
SERVO PISTON
PIVOT VALVE PLUNGER
3780

Fig. 8 - Cross-Section of Limiting Speed Hydraulic Governor for 16V Engine

c. If the pointer indicates less than 18° at approximately 300 rpm below the top no-load speed, the band-level is too high. The adjusting nut should be turned counterclockwise, in small increments, until the pointer indicates exactly 18° at the above speed. If the band-level is too high , the engine speed may fall several hundred rpm below the top no-load speed even though the speed control lever is in the maximum speed position.

d. Reset the idle speed, if the band-level has been changed.

Adjust Maximum No-Load Speed

1. Remove the sub-cap assembly, including the idle speed spring. Since the sub-cap is dowelled to the governor housing, removal will be made easier by

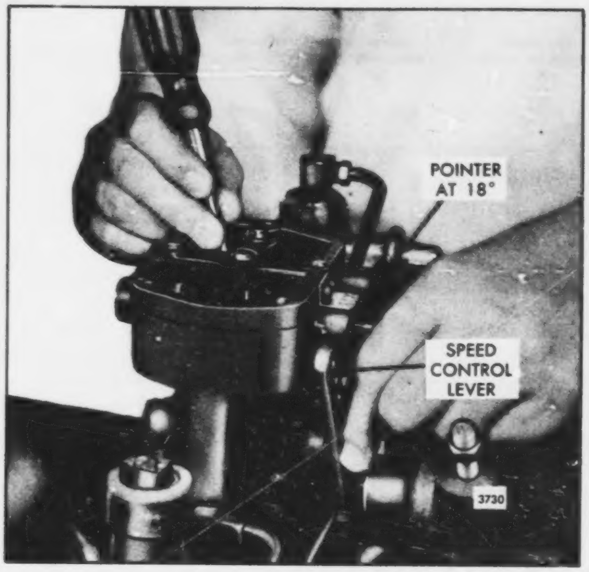


Fig. 9 - Moving Flyweight with Screw Driver

moving the linkage so the pointer is near the 36° mark.

CAUTION: Hold the idle speed spring seat or spring with your finger, as shown in Fig. 11, to prevent it from falling into the governor housing.

2. Loosen the small set screw (on the side opposite the anti-rotating pin) in the high speed spring cage with a 5/64" Allen wrench (Figs. 8 and 12).

3. Turn the high speed adjusting nut up to decrease or down to increase the speed (Fig. 13).

NOTE: A 1/6th turn of the nut changes the speed 30-40 rpm. Use a 1/4" Allen wrench (the end of the wrench should be ground flat or slightly concave).

4. Tighten the small set screw to lock the adjusting nut in place.

5. Check to make sure the idle speed adjusting pin is in position and place the idle speed spring against the spring seat. Then, holding the spring in place with your finger (Fig. 11) and holding the linkage so the pointer is near the 36° mark, install the sub-cap assembly. Make sure the pin in the speed droop adjusting bracket enters the slot in the floating lever.

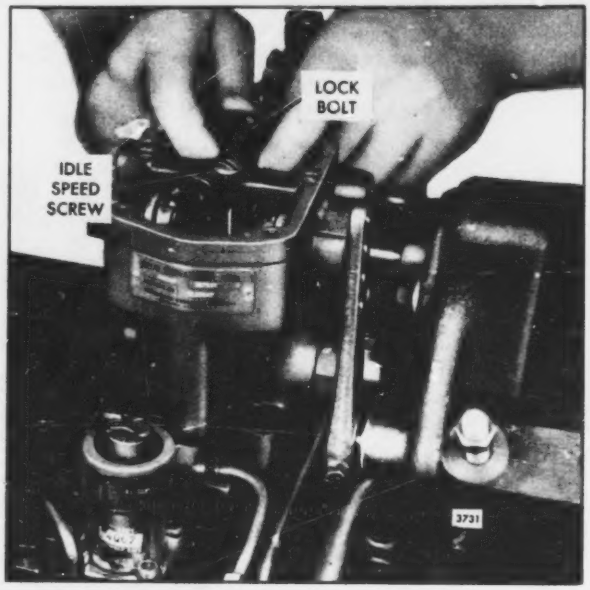


Fig. 10 - Adjusting Band-Level

6. Reset the band-level adjustment.

7. Reset the idle speed.

8. Check the maximum speed.

9. Check the engine speed by suddenly moving the speed control lever from idle to maximum. If the engine speed does not stabilize after two to four surges, move the droop bracket outward. Recheck the idle and maximum speeds.

10. Install the governor cover and tighten the screws.

Adjust Buffer Screw

The purpose of the buffer screw adjustment is to prevent the injector racks from going all the way to the no-fuel position and causing the engine to stall.

1. With the warm engine at idle, turn the buffer screw in until it just touches the lower left end of the differential lever. Then, back off three complete turns and tighten the lock nut.

2. Install the cover on the governor control housing.

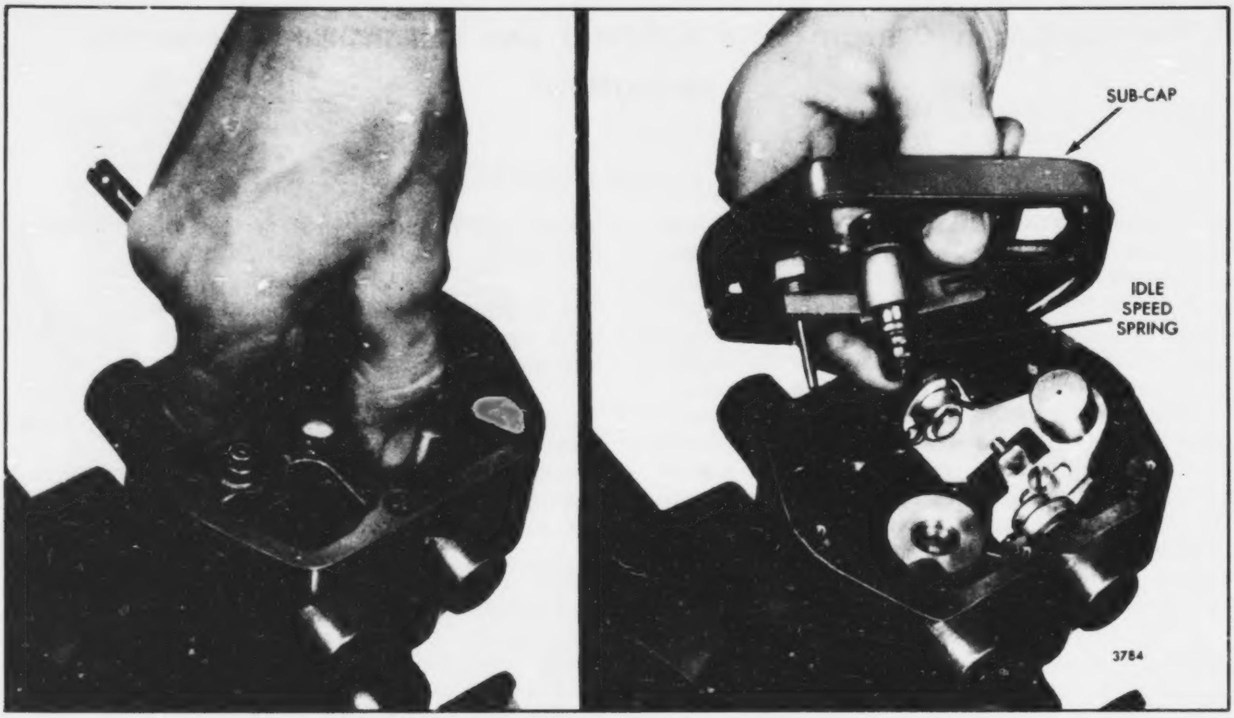

SUB-CAP
IDLE SPEED SPRING
3784

Fig. 11 - Removing or Installing Governor Sub-Cap Assembly

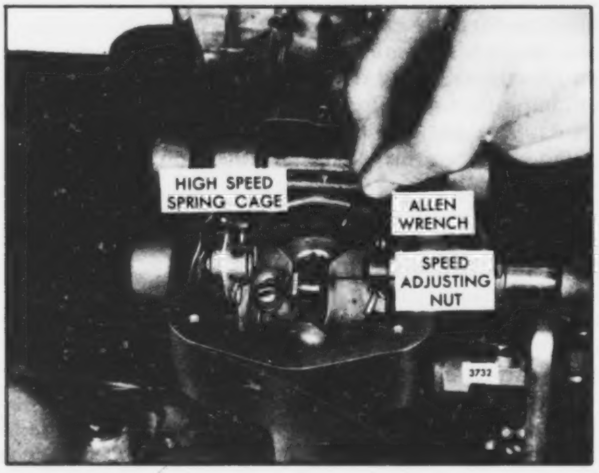

HIGH SPEED SPRING CAGE
ALLEN WRENCH
SPEED ADJUSTING NUT
3732

Fig. 12 - Loosening Allen Screw on Spring Cage

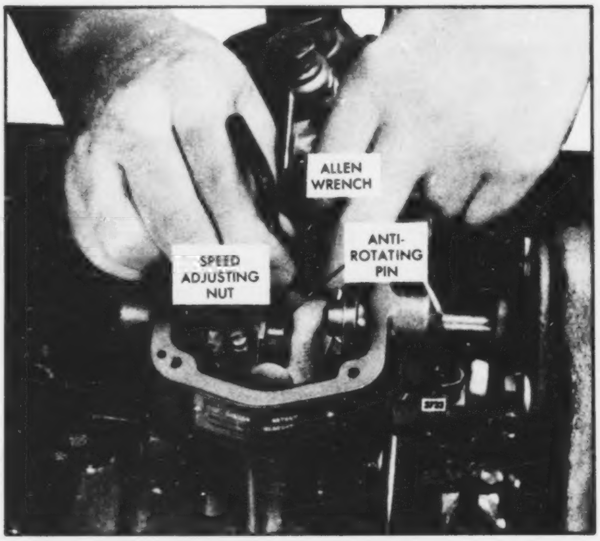

ALLEN WRENCH
ANTI-ROTATING PIN
SPEED ADJUSTING NUT

Fig. 13 - Turning High Speed Adjusting Nut

HYDRAULIC GOVERNOR (EG-B ELECTRIC) AND INJECTOR RACK CONTROL ADJUSTMENT

6, 8 and 12V ENGINES

The Woodward EG-B2C series governor (Fig. 1) is of the electric type. It can be operated as an isochronous (zero speed droop) governor or as a speed droop governor. As an isochronous governor installed on an engine operating alone, it will maintain a constant speed for all loads within the capacity of the engine, except momentarily at the time a load change occurs. Paralleled with other EG-governors, it will render proportional load division with isochronous control. Paralleled with dissimilar governors or with an infinite bus (i.e., commercial power), the EG-B2C governor can be operated as a conventional speed droop governor, and the load carried by the engine will be a function of the governor speed setting and speed droop setting.

The governor consists essentially of three separate assemblies: a control box, a speed adjusting potentiometer, and a hydraulic actuator. A resistor box assembly is required when the control box receives load signals from an engine driven alternator.

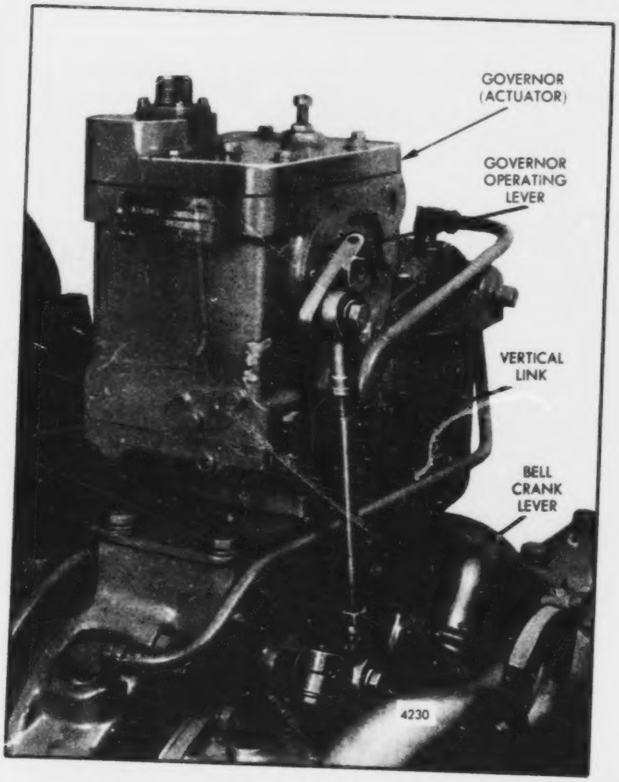


Fig. 1 - Governor Mounted on Engine

The output signal of the control box serves as the input signal to the hydraulic actuator; the actuator in turn controls the fuel to the engine.

The EG-B hydraulic actuator has a centrifugal head assembly to control the engine during starting; also, it will limit the maximum engine speed if the control box signal is interrupted or if it fails in such a manner as to call for maximum fuel.

Used with the control box, the EG-B actuator provides, in effect, two governors in one: an electric governor and a centrifugal governor, each independently capable of positioning the terminal (output) shaft. During normal operation, the electric governor controls fuel to the engine. The actuator is adjusted so that, if the electric control signal is interrupted, the electric section moves the fuel linkage to maximum fuel. When the speed reaches the level for which the centrifugal governor is set (always a level higher than that for which the electric governor is set), this section assumes and maintains control of the engine. Speed can then be reduced, if desired, by lowering the speed setting on the centrifugal governor. Should the control box fail in such a way as to emit a continuous signal calling for a decrease in fuel, the unit would shut down.

The essential element of the electric section of the actuator is an electro-hydraulic transducer which directs pressure oil to and from the power piston which actuates the fuel mechanism. The transducer consists of a polarized magnet to which is attached the pilot valve plunger controlling oil flow to and from the power piston. The solenoid responds to the push-pull output of the electric control box and, in so doing, moves the pilot valve plunger up or down. Through connecting linkage, the power piston moves the terminal (output) shaft of the actuator. The engine fuel linkage attaches to the actuator terminal shaft.

The governor (actuator) uses oil from the engine lubrication system.

For more detailed information on the electrical section and on servicing the EG-B2C governor, refer to the Woodward Governor Company's Bulletins 37709 and 37706 (also 37702 for type EG-B1 governor).

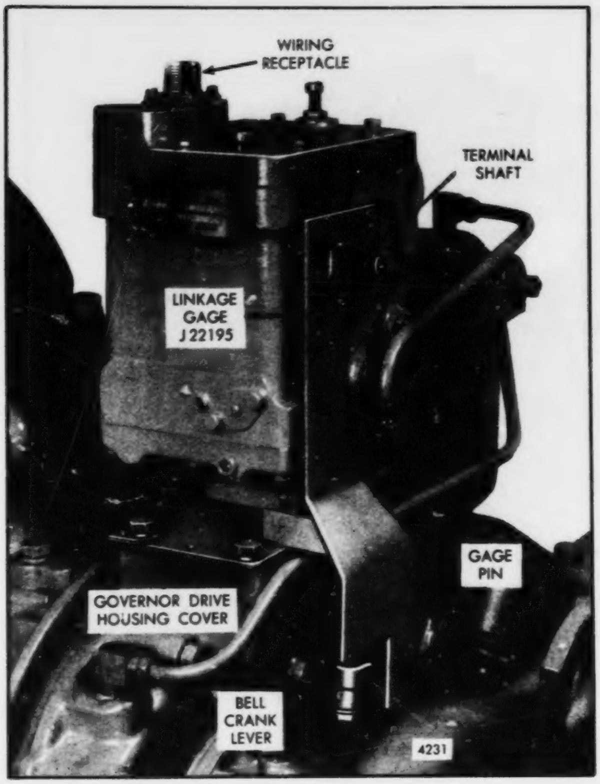


Fig. 2 - Linkage Gage in Position

Position Injector Rack Control Levers and Adjust Governor Linkage

After adjusting the exhaust valves and timing the fuel injectors, position the injector rack control levers and adjust the governor linkage.

The position of the injector control racks must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

The letters R and L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. Cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the No. 1R injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Clean and remove the valve rocker covers.

2. Loosen all of the inner and outer injector rack control lever adjusting screws on both injector control tubes. Be sure all of the injector rack control levers are free on the control tubes.

3. Remove the vertical link assembly (Fig. 1) from the governor operating lever and the bell crank lever.

4. Loosen the clamping bolt and slide the governor operating lever from the governor terminal shaft.

5. Place the linkage gage J 22195 over the governor terminal shaft and insert the gage pin in the bell crank lever bolt hole (Fig. 2). The tang on the side of the gage should just touch the top of the governor drive housing when the gage is properly positioned. The gage will hold the injector control racks in the full-fuel position while the levers are being adjusted.

6. Remove the clevis pin from the fuel rod and the left cylinder bank injector control tube lever.

7. Turn the inner adjusting screw of the No. 1R injector rack control lever down (Fig. 3) until a slight movement of the control tube is observed, or a step-up in effort to turn the screw driver is noted. This will place the No. 1R injector rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector tube. Then alternately tighten both the inner and outer adjusting screws.

> **CAUTION:** Avoid setting the rack too tight, causing the fuel rod to bend.

8. To be sure the control lever is properly adjusted, press down on the injector rack with a screw driver or finger tip. The setting is sufficiently tight if the rack returns to its original position when the pressure is released.

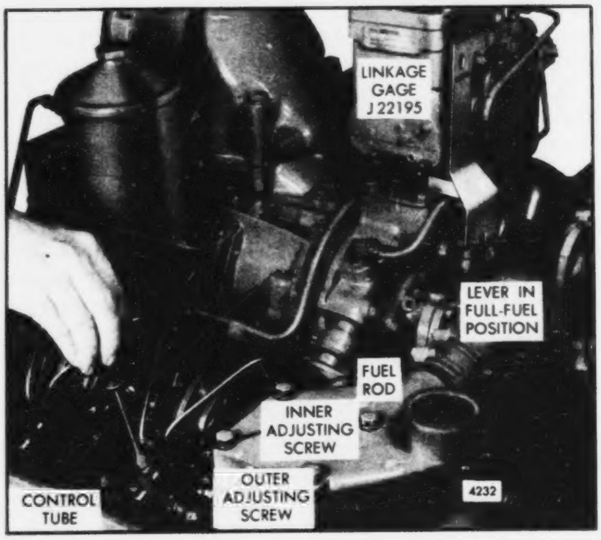


Fig. 3 - Positioning No. 1R Injector Rack Control Lever

9. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.

10. Install the clevis pin in the fuel rod and the left cylinder bank injector control tube lever. Then position the No. 1L injector rack control lever as outlined in Steps 7 and 8.

11. Install the clevis pin in the fuel rod and the right cylinder bank injector control tube lever. Recheck the No. 1R and 1L injector rack control levers as in Step 8. Check for and eliminate any deflection in the fuel rods. If the settings are correct, both injector racks will be in the full-fuel position and snug on the ball end of the control levers.

12. Manually hold the No. 1R injector rack in the full-fuel position by means of the injector control tube lever. Turn down the inner adjusting screw of the No. 2R injector rack control lever until the injector rack moves into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

13. Recheck the No. 1R injector rack to be sure it has remained snug on the ball end of the rack control lever while positioning the No. 2R injector rack. If the rack of No. 1R injector has become loose, back off the inner adjusting screw on the No. 2R injector rack control lever slightly and tighten the outer adjusting screw. When the settings are correct, both injector racks will respond in the same manner on the ball end of their respective rack control levers.

14. Position the remaining injector rack control levers on the right and left bank cylinder heads as outlined in Step 12. When the settings are correct, all of the injector racks will be snug on the ball end of the control levers when the injector control tube levers are held in the full-fuel position.

15. Turn the terminal shaft clockwise to the no-fuel position. Then place the governor operating lever on the terminal shaft so that the bolt hole in the lever is aligned with the center of the slot in the linkage gage (Fig. 4). Remove the gage and tighten the clamping bolt on the lever.

16. Move the bell crank lever to the no-fuel position.

17. Adjust the length of the vertical link so the bolt holes in the two levers and the rod end bearings in the vertical link are in alignment.

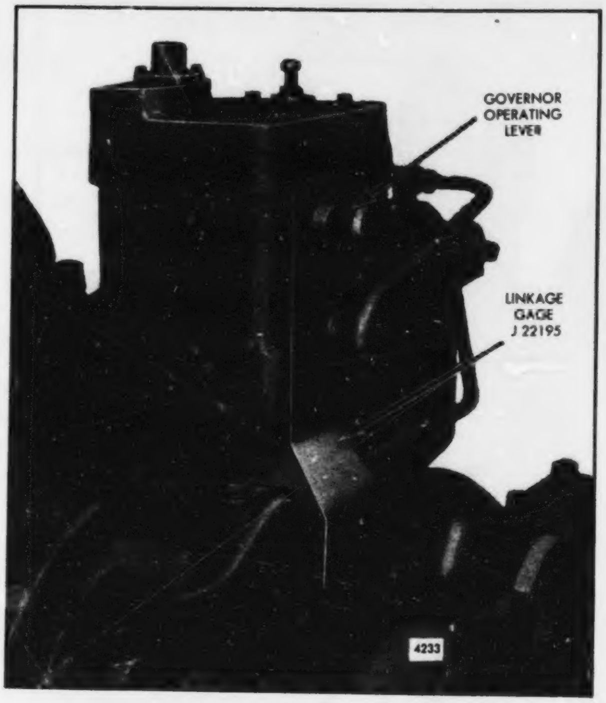


Fig. 4 - Governor Operating Lever in Position

18. Install and tighten the vertical link attaching bolts.

19. As an additional check, the governor operating lever should be in a position indicating maximum on the dial indicator (Fig. 6), when the injector rack control levers are in the full-fuel position. If not, readjust the vertical link.

20. Use a new gasket and install the valve rocker cover on each cylinder head.

Governor Adjustments

The centrifugal governor section of the actuator has three operating adjustments.

1. *Speed setting:* An external adjustment used to set the speed at which the centrifugal governor will control.

2. *Speed droop:* An internal adjustment used to permit parallel operation of units controlled by the centrifugal governor.

3. *Needle Valve:* An external adjustment used to stabilize the centrifugal governor.

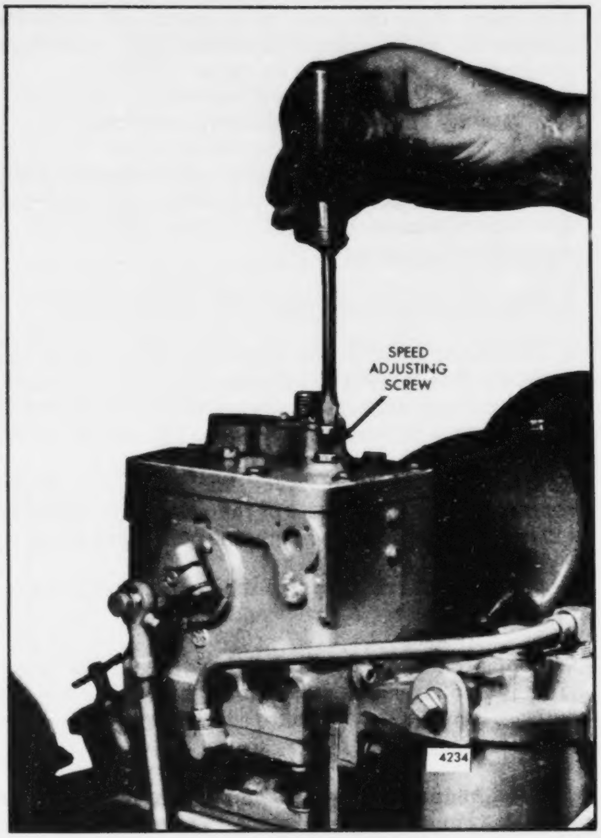


Fig. 5 - Adjusting Maximum No-Load Engine Speed

Once set, these adjustments do not usually require further adjustment.

Adjust Maximum No-Load Speed

When shipped from the factory, the speed adjusting screw is set for a speed approximately 4-1/2% above rated speed at no-load (the usual factory droop setting of 3% will reduce the speed to approximately 1-1/2% above rated speed at full travel of the centrifugal governor power piston). With the speed adjusting screw at this setting during normal operation (i.e., with the electric section controlling), the centrifugal governor power piston will be held in its maximum fuel position.

If adjustment of the maximum no-load speed is required, proceed as follows:

1. Disconnect the wiring at the receptacle on the governor cover.

2. Start the engine and run it at no-load.

3. Turn the speed adjusting screw (Fig. 5) until the desired speed is obtained. Turning the screw counterclockwise will decrease the speed setting.

Adjust Needle Valve

When starting the engine for the first time, eliminate any air which may be trapped in the actuator oil passages as follows:

1. Open the needle valve of the centrifugal governor section (Fig. 6) until the engine hunts or surges. After a half minute, gradually close the needle valve until the engine speed just stabilizes. Closing the needle valve farther than necessary will make the governor slow to return to normal speed after a load change. Never close the needle valve tight.

2. Test the action by manually disturbing the speed of the engine. The engine should promptly return to its original steady-state speed with only a small overshoot or undershoot.

Speed Droop Adjustment

The governor is set with approximately 3% droop when shipped from the factory. When the electric governor section is controlling the engine, the speed

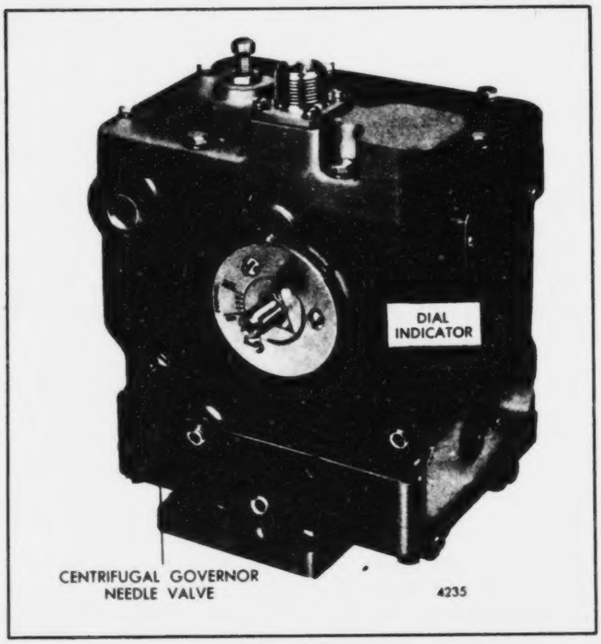


Fig. 6 - Location of Centrifugal Governor Needle Valve

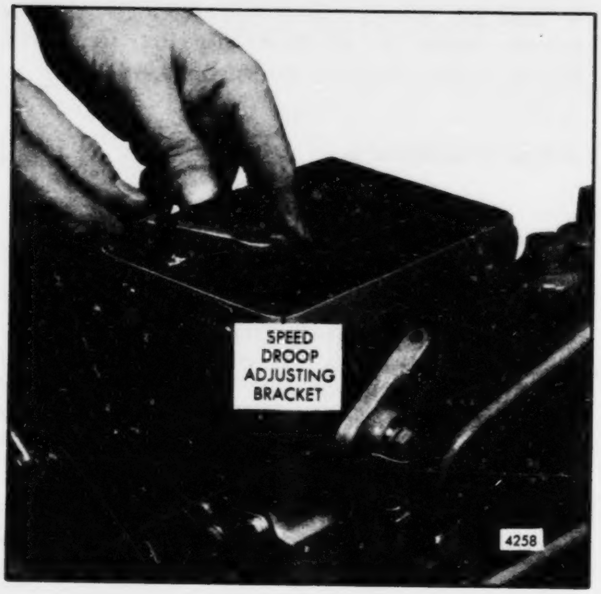


Fig. 7 – Adjusting Speed Droop

droop adjustment has no effect on operation and should be left as factory set. When, for some reason, the centrifugal governor section is controlling the engine, the speed droop setting can be adjusted, if necessary, to suit the operating requirements. The governor should never be set at "zero" droop unless the unit is maintaining the frequency of paralleled alternators or is operating as a single, isolated unit. Not more than one unit in a system of paralleled alternators with engines controlled by centrifugal governors can be operated on "zero" droop.

If necessary, adjust the speed droop as follows:

1. Start the engine and run it at approximately half-load until the lubricating oil temperature is stabilized; governor regulation will become more stable as the oil temperature increases.

2. Stop the engine and remove the actuator cover.

3. Loosen the speed droop adjusting bracket screw and move the bracket (Fig. 7) slightly to obtain the desired droop; moving the bracket toward the flyweight end of the actuator will increase the droop. Tighten the screw.

4. Install the actuator cover and, with the engine running, adjust the speed until the engine is operating at the desired speed above the rated full-load speed.

5. Apply the full rated load on the engine and readjust the speed to the correct full-load speed.

6. Remove the rated load and note the engine speed after it stabilizes under no load. If necessary, stop the engine, remove the actuator cover and readjust the speed droop bracket.

After the engine tune-up is completed, reconnect the electrical circuit of the governor at the receptacle on the actuator cover. If necessary, refer to the Woodward Governor Company's Bulletin 37709 for the procedures to be followed in checking the electrical system.

16V ENGINE

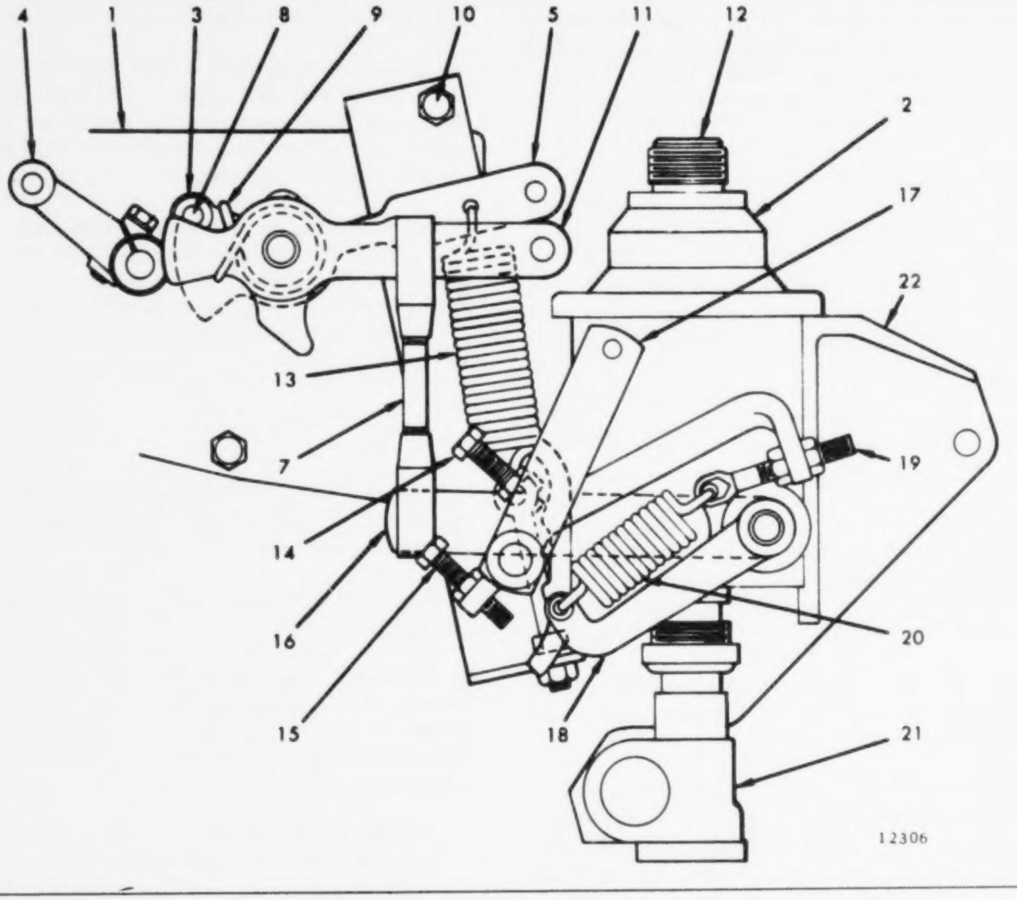
The tune-up procedure for a 16V engine equipped with the EG-B electric governor is similar to the procedure used on the 6, 8 or 12V engines. To position the injector rack control levers, use the same linkage gage (J 22195) but follow the procedure outlined in the variable speed hydraulic governor (6, 8 and 12V) or in the variable speed hydraulic governor (16V). The governor adjustments, however, are the same as on the 6, 8 and 12V engines.

MECHANICAL OUTPUT SHAFT GOVERNOR AND LINKAGE ADJUSTMENT

A Pierce mechanical governor is used to maintain a near constant output shaft speed on engines equipped with a torque converter. The governor is mounted at the front of the engine (Fig. 1) and driven by a flexible shaft from the converter output shaft.

The output shaft governor is lubricated by engine oil contained within the governor housing. The governor sump is filled through the hinged cap oiler until the oil begins to drip out of the oil level hole. After filling, a plug is installed in the oil level hole to prevent leakage. The oil level should be checked every 8 service hours and changed every 500 hours.

The output shaft governor is connected to the engine governor by control rods and levers as illustrated in Fig. 1. The control rod end ball joints are sealed assemblies and do not require lubrication. Other moving parts of the control linkage should be lubricated with engine oil.



1. Governor--Engine
2. Governor--Output Shaft
3. Lever--Throttle Control
4. Lever--Shutdown
5. Lever--Engine Governor Operating
7. Rod--Output Shaft Governor
8. Pin--Stop
9. Spring--Torsion
10. Bolt (Stop)
11. Lever--Output Shaft Governor
12. Drive--Flexible Shaft
13. Spring--Governor Lever Return
14. Bolt--Minimum Speed Adjusting
15. Bolt--Maximum Speed Adjusting
16. Lever--Rocker Shaft
17. Lever--Speed Adjusting
18. Lever--Spring
19. Eyebolt--Droop Adjusting
20. Spring--Speed Adjusting
21. Drive--Tachometer
22. Bracket--Output Shaft Governor Mounting

Fig. 1 - Mechanical Output Shaft Governor and Linkage

The centrifugal force of the revolving output shaft governor flyweights is converted into linear motion which is transmitted through a riser, thrust bearing, operating fork, and rocker shaft to an external speed adjusting spring. The speed of the torque converter output shaft is governed by the tension of the speed adjusting spring. This spring tension is established by the operator when he moves the output shaft governor speed adjusting lever to the desired speed setting.

The engine governor operating lever is positioned by the operator to limit the maximum fuel input to the engine. For most purposes, such as drag line and shovel operation, the lever is advanced to its maximum position to permit the output shaft governor to obtain full power from the engine. The lever may be used as an overrule lever when performing such jobs as laying of structural steel. A spring is used to return the lever to the idle position. Travel of the governor operating lever is limited by a stop (bolt).

The engine governor throttle control lever is pinned to the throttle shaft. The engine governor operating lever is mounted below the throttle control lever and rides on the throttle shaft boss on the governor cover. The output shaft governor lever is mounted above the throttle control lever and is retained on the shaft by a snap ring. A stop pin, pressed into the throttle control lever, transmits movement of the output shaft governor lever and/or engine governor operating lever through the throttle control lever to the injector racks. The torsion spring, used to retain the throttle control lever stop pin against the output shaft governor lever, yields to permit the governor operating lever to move the throttle control lever toward the idle position, regardless of the position of the output shaft governor lever. A slot in the underside of the governor cover hub limits the travel of the throttle control lever in both its maximum and minimum speed positions.

Movement of the output shaft governor speed adjusting lever is limited by the maximum and minimum speed adjusting bolts.

The engine shutdown lever is connected through a shaft to another lever, under the governor cover, which bears against the pin in the differential lever. To stop the engine, the shutdown lever is used to move the differential lever to the no-fuel position.

Operation

When the output shaft governor speed adjusting lever is advanced, the tension on the speed adjusting spring is increased. The force resulting from the increased spring tension is transmitted through the rocker shaft lever and control linkage to the throttle control lever which advances the injector racks. Engine speed increases, as a result of the increased fuel, until the output shaft governor weight force is sufficient to balance the increased spring tension. The weights then move against the spring and reduce the injector rack fuel setting to an amount sufficient to maintain the higher engine speed setting.

If the operator moves the speed adjusting shaft lever to a decreased speed position, the tension on the speed adjusting spring will decrease and the governor weights will overcome the spring tension and move the rocker shaft lever to a decreased fuel position. The engine speed will be reduced until the force of the output shaft governor weights equals the tension of the speed adjusting spring. The engine will then operate at the desired reduced engine speed.

When a load is applied to the unit, the output shaft slows down and the force exerted by the governor flyweights is reduced, allowing the spring to move the rocker shaft lever to an increased fuel position to provide sufficient power to equal the new load.

When the load on the unit is removed, the output shaft speed will increase and the force exerted by the governor flyweights will increase, overcoming the spring tension and moving the rocker shaft lever to a decreased fuel position to reduce the power to match the reduced load.

Tune-Up

Adjust the exhaust valve clearance, time the fuel injectors and adjust the engine and output shaft governors as follows:

1. Adjust the exhaust valve clearance and time the injectors.

2. Disconnect the output shaft governor rod and the linkage to the engine governor operating lever. Then adjust the engine governor as outlined under *Limiting Speed Mechanical Governor and Injector Rack Control Adjustment*.

> **NOTE:** Set the No-Load engine speed to that specified on the engine option plate. The No-Load speed varies with the converter used and the maximum output shaft speed setting.

3. Reconnect the linkage to the governor operating lever and check the total travel of the operating lever. The lever should move the stop (bolt) in one direction and the governor lever return spring should move the lever, in the other direction, until the throttle control lever reaches the end of its travel.

4. Move the governor operating lever to the maximum speed position (against the stop bolt).

5. Move the output shaft governor rocker shaft lever to the maximum fuel position and retain it by moving the speed adjusting lever to the full-speed position. Then move the output shaft governor lever and the throttle control lever together to the maximum speed position and retain there.

NOTE: This operation closes the low speed gap which may require more torque than is available from the torsion spring between the above two levers. Thus, it is important that they be held together, permitting no space between the throttle control lever pin and the arm of the output shaft governor lever.

6. Adjust the output shaft governor rod length until it will just slide into the inner hole of the output shaft governor lever (Fig. 1). Then, increase the length of the rod until there is approximately .020" clearance between the stop pin and the output shaft governor lever. Tighten the adjustment.

7. Adjust the governor operating lever return spring by retaining the rocker shaft lever in the full-speed position and increasing the tension on the spring by adjusting the eye bolt and nuts, until the tension of the torsion spring is overcome and the throttle control lever is moved against its stop in the idle position.

8. Move the output shaft governor speed adjusting lever to the minimum speed position and start the engine.

9. Advance the output shaft governor speed adjusting lever to the desired maximum output shaft speed and adjust the maximum speed adjusting bolt to retain the lever.

10. Move the output shaft governor speed adjusting shaft lever to the desired minimum speed position and adjust the minimum speed adjusting bolt to retain the lever.

11. Recheck the output shaft maximum and minimum speeds and readjust the position of the speed adjusting bolts, if necessary.

12. To check the unit for stability as affected by governor speed droop, move the speed adjusting shaft lever, with the engine operating at no load, to the maximum speed position. Then move the output shaft governor rod to cause a speed decrease of several hundred rpm. Release the rod and check for hunting when the governor returns the engine to the maximum speed setting. If the engine stabilizes in less than three surges, the droop may be set too high; if the engine does not stabilize in five surges, the droop may be set too low. Set the speed droop as follows:

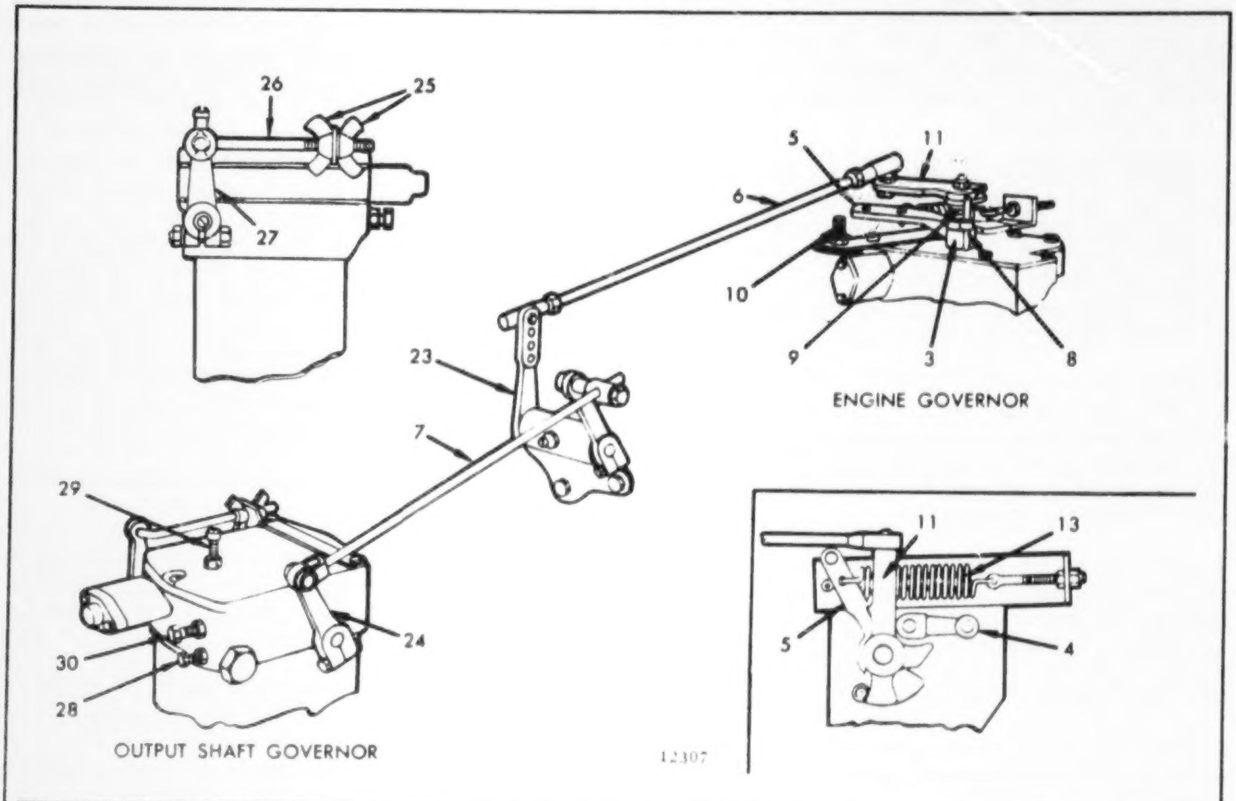
a. If the engine hunts less than three surges, back off the inner speed adjusting spring eye bolt nut one full turn and tighten the inner nut one turn to retain the adjustment. If the engine hunts more than five surges, back off the outer speed adjusting spring eye bolt nut one full turn and tighten the outer nut one turn to retain the adjustment.

NOTE: The eye of the bolt must be in a horizontal plane to avoid twisting the spring.

b. Reset the maximum engine no-load speed, if necessary, as outlined in Steps 9 and 10.

c. Recheck the speed droop. The engine speed should be stable when the governor droop is 7-1/2% to 10% of the full-load speed. For example, at an output shaft speed setting of 1800 rpm full load, the output shaft speed droop should be 150 to 200 rpm. Therefore, the no-load output shaft speed should be set at 1950 to 2000 rpm.

HYDRAULIC OUTPUT SHAFT GOVERNOR AND LINKAGE ADJUSTMENT



3. Lever--Throttle Control
4. Lever--Shutdown
5. Lever--Engine Governor Operating
6. Rod--Engine Governor
7. Rod--Output Shaft Governor
8. Pin--Stop
9. Spring--Torsion
10. Bolt (Stop)
11. Lever--Output Shaft Governor
13. Spring--Governor Lever Return
23. Lever--Throttle Control Rear Cross Shaft
24. Lever--Output Shaft Governor Control
25. Wing Nut--Speed Adjusting
26. Link--Sliding
27. Lever--Speed Control
28. Screw--Maximum Speed Limit Adjusting
29. Screw--Minimum Speed Limit Adjusting
30. Screw--Maximum Fuel Adjusting

Fig. 1 - Hydraulic Output Shaft Governor and Linkage

A hydraulic governor is used to maintain a near constant output shaft speed on engines equipped with a Series 500 or larger Torqmatic converter. The governor is mounted on the converter and gear driven from the output shaft.

The output shaft governor is connected to the engine governor by control rods and levers (Fig. 1). The control rod end ball joints are sealed assemblies and do not require lubrication. Other moving parts of the control linkage should be lubricated with engine oil.

In most applications, such as drag line and shovel operation, it is desirable to have the output shaft governor control the fuel input to maintain a relatively constant output shaft speed. The output shaft speed will be constant up to full power of the engine, except for the amount of governor droop. The speed setting of the engine governor must be sufficiently higher than the speed setting of the output shaft governor so the engine governor will not reduce the fuel input to the engine before full power is required by the output shaft governor. As load is applied to the output shaft, the output shaft speed will decrease gradually up to the amount of the output shaft governor droop at full load. At the same time, the engine speed will gradually increase until full load is reached.

In some types of operation, such as laying of structural steel, it is desirable to operate the unit with a very low output shaft speed. This speed could be so low that the output shaft governor ball head assembly would not actuate the governor pilot valve and spring seat assembly. In such applications, the engine governor operating lever, used as an overrule lever, can be moved toward the idle speed position sufficiently to provide the desired low output shaft speed. Output shaft speeds down to zero can be obtained through this type of engine governor control. The engine governor would maintain control unless the output shaft speed increased to the speed setting of the output shaft governor.

Adjustments

The engine governor throttle control lever (Fig. 1) is pinned to the throttle shaft. The engine governor operating lever is mounted below the throttle control lever and rides on the throttle shaft boss on the governor cover. The output shaft governor lever is mounted above the throttle control lever and is retained on the shaft by a snap ring. A stop pin, pressed into the throttle control lever, transmits movement of the output shaft governor lever and/or engine governor operating lever through the throttle control lever to the injector racks. The torsion spring, used to retain the throttle control lever stop pin against the output shaft governor lever, yields to permit the governor operating lever to move the throttle control lever toward the idle position, regardless of the position of the output shaft governor control lever. A slot in the underside of the governor cover hub limits the travel of the throttle control lever in both the maximum and minimum speed positions.

The engine shutdown lever is connected through a shaft to another lever, under the governor cover, which bears against the pin in the differential lever. To stop the engine, the shutdown lever is used to move the differential lever to the no-fuel position.

The following linkage and governor adjustments should be made with the engine stopped and after the limiting speed engine governor has been adjusted.

1. Connect the linkage to the governor operating lever and check the total travel of the lever. The lever should move to the stop bolt in one direction and the governor lever return spring should move the lever, in the other direction, until the throttle control lever reaches the end of its travel.

2. Move the governor operating lever to the maximum speed position (against the stop bolt).

3. Move the output shaft governor control lever to the full-fuel position and retain it by moving the speed control lever to the maximum speed position. Then move the output shaft governor lever (on the engine governor cover) and the throttle control lever together to the maximum speed position and retain there.

> **NOTE:** This operation closes the low speed gap (in the engine governor) which may require more torque than is available from the torsion spring between the two levers. Thus, it is important that they be held together, permitting no space between the throttle control lever pin and the arm of the output shaft governor lever.

4. To adjust the linkage between the output shaft governor and the engine governor, loosen the output shaft governor rod clamping bolt in the ball joint in the rear cross-shaft lever. Next, move the output shaft governor rod until there is approximately .020" clearance between the stop pin and the output shaft governor lever. Then tighten the clamping bolt securely.

> **NOTE:** The engine governor control rod is connected to the outer bolt hole in the output shaft governor lever.

5. To adjust the governor operating lever return spring, retain the output shaft governor control lever in the full-fuel position and increase the tension on the spring by adjusting the eye bolt and lock nuts until the tension of the torsion spring is overcome and the throttle control lever is moved against the stop in the idle position.

Final Adjustments

Move the output shaft governor lever in the idle speed position and start the engine.

After the engine reaches normal operating temperature, advance the output shaft governor speed control lever to the maximum speed position and check the Torqmatic converter output shaft speed. This speed will vary depending upon engine application.

If it is necessary to adjust the output shaft speed, loosen the wing nuts on the sliding link and move the speed control lever to increase or decrease the speed as needed.

The output shaft governor is driven through the converter and there is a high droop. Therefore, the no-load speed setting should be at least 150 rpm higher than the desired full-load speed setting. Tighten the wing nuts after completing the adjustment.

CAUTION: Do not set the Torqmatic converter output shaft speed in excess of the speed specified by the equipment manufacturer, to prevent damage to the driven machinery.

It will be noted during engine operation that the minimum droop will vary between 150 and 175 rpm. If the droop requires adjustment, move the droop bracket (inside the output shaft governor) to decrease or increase the amount of droop.

NOTE: To compensate for the output shaft speed droop, the engine no-load speed must be set approximately 175 rpm above the required engine full-load speed.

Move the output shaft governor speed control lever to the idle speed position and adjust the idle speed by means of the minimum speed limit adjusting screw.

The maximum fuel adjusting screw and the maximum speed limit adjusting screw are not used and should be backed out to prevent interference.

STORAGE

PREPARING ENGINE FOR STORAGE

When an engine is to be stored or removed from operation for a period of time, special precautions should be taken to protect the interior and exterior of the engine, transmission and other parts from rust accumulation and corrosion. The parts requiring attention and the recommended preparations are given below.

It will be necessary to remove all rust or corrosion completely from any exposed part before applying a rust preventive compound. Therefore, it is recommended that the engine be processed for storage as soon as possible after removal from operation.

The engine should be stored in a building which is dry and can be heated during the winter months. Moisture absorbing chemicals are available commercially for use when excessive dampness prevails in the storage area.

TEMPORARY STORAGE (30 days or less)

To protect an engine for a temporary period of time, proceed as follows:

1. Drain the engine crankcase.

2. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.

3. Fill the fuel tank with the recommended grade of fuel oil. Operate the engine for two minutes at 1200 rpm and no load.

> **NOTE:** Do not drain the fuel system or the crankcase after this run.

4. Check the air cleaner and service it, if necessary, as outlined under *Air System.*

5. If freezing weather is expected during the storage period, add a high boiling point type antifreeze solution in accordance with the manufacturer's recommendations. Drain the raw water system and leave the drain cocks open.

6. Clean the entire exterior of the engine (except the electrical system) with fuel oil and dry it with air.

7. Seal all of the engine openings. The material used for this purpose must be water proof, vaporproof and possess sufficient physical strength to resist puncture and damage from the expansion of entrapped air.

An engine prepared in this manner can be returned to service in a short time by removing the seals at the engine openings, checking the engine coolant, fuel oil, lubricating oil, transmission and priming the raw water pump, if used.

EXTENDED STORAGE (30 days or more)

When an engine is to be removed from operation for an extended period of time, prepare it as follows:

1. Drain and thoroughly flush the cooling system with clean, soft water.

2. Refill the cooling system with clean, soft water.

3. Add a rust inhibitor to the cooling system (refer to *Corrosion Inhibitor* under *Cooling System).*

4. Remove, check and recondition the injectors, if necessary, to make sure they will be ready to operate when the engine is restored to service.

5. Reinstall the injectors in the engine, time them, and adjust the valve clearance.

6. Circulate the coolant through the entire system by operating the engine until normal operating temperature is reached (160-185° F or 71-85° C).

7. Stop the engine.

8. Remove the drain plug and completely drain the engine crankcase. Reinstall and tighten the drain plug. Install new lubricating oil filter elements and gaskets.

9. Fill the crankcase to the proper level with a 30-weight preservative lubricating oil MIL-L-21260, Grade 2 (P10), or equivalent.

10. Drain the engine fuel tank.

11. Refill the fuel tank with enough rust preventive fuel oil such as American Oil Diesel Run-In Fuel

(LF 4089), Mobil 4Y17, or equivalent, to enable the engine to operate 10 minutes.

12. Drain the fuel filter and strainer. Remove the retaining bolts, shells and elements. Discard the used elements and gaskets. Wash the shells in clean fuel oil and insert new elements. Fill the cavity between the element and shell about two-thirds full of the same rust preventive compound as used in the fuel tank and reinstall the shell.

13. Operate the engine for 10 minutes to circulate the rust preventive throughout the engine.

14. Refer to *Air System* and service the air cleaner.

15. MARINE GEAR

a. Drain the oil completely and refill with clean oil of the proper viscosity and grade as is recommended. Remove, clean or replace the strainer and replace the filter element.

b. Start and run the engine at 600 rpm for 10 minutes so that clean oil can coat all of the internal parts of the marine gear. Engage the clutches alternately to circulate clean oil through all of the moving parts.

16. TORQMATIC CONVERTER

a. Start the engine and operate it until the temperature of the converter oil reaches 150° F (66° C).

b. Remove the drain plug and drain the converter.

c. Remove the filter element.

d. Start the engine and stall the converter for twenty seconds at 1000 rpm to scavenge the oil from the converter. *Due to lack of lubrication, do not exceed the 20 second limit.*

e. Install the drain plug and a new filter element.

f. Fill the converter to the proper operating level with a commercial preservative oil which meets Government specifications MIL-L-21260, Grade 1. Oil of this type is available from the major oil companies.

g. Start the engine and operate the converter for at least 10 minutes at a minimum of 1000 rpm. Engage the clutch, then stall the converter to raise the oil temperature to 225° F (107° C).

CAUTION: Do not allow the oil temperature to exceed 225° F (107° C). If the unit does not have a temperature gage, *do not stall the converter for more than thirty seconds.*

h. Stop the engine and permit the converter to cool to a temperature suitable to touch.

i. Seal all of the exposed openings and the breather with moisture proof tape.

j. Coat all exposed, unpainted surfaces with preservative grease. Position all of the controls for minimum exposure and coat them with grease. The external shafts, flanges and seals should also be coated with grease.

17. POWER TAKE-OFF

a. Use an all purpose grease such as Shell Alvania No. 2, or equivalent, and lubricate the clutch throwout bearing, clutch pilot bearing, drive shaft main bearing, clutch release shaft, and the outboard bearings (if so equipped).

b. Remove the inspection hole cover on the clutch housing and lubricate the clutch release lever and link pins with a hand oiler. Avoid getting oil on the clutch facing.

c. If the unit is equipped with a reduction gear, drain and flush the gear box with light engine oil. If the unit is equipped with a filter, clean the shell and replace the filter element. Refill the gear box to the proper level with the grade of oil indicated on the name plate.

18. HYDROSTARTER SYSTEM

Refer to *Hydraulic Starting System* in the section on *Engine Equipment* for the lubrication and preventive maintenance procedure.

19. TURBOCHARGER

The turbocharger bearings are lubricated by pressure through the external oil line leading from the engine cylinder block while performing the previous operations above and no further attention is required.

20. Apply a *non-friction* rust preventive compound, to all exposed parts. If it is convenient, apply the rust preventive compound to the engine flywheel. If not, disengage the clutch mechanism to prevent the clutch disc from sticking to the flywheel.

CAUTION: Do not apply oil, grease or any wax base compound to the flywheel. The cast iron will absorb these substances which can "sweat" out during operation and cause the clutch to slip.

21. Drain the engine cooling system.

22. The oil may be drained from the engine crankcase if so desired. If the oil is drained, reinstall and tighten the drain plug.

23. Remove and clean the battery and battery cables with a baking soda solution and rinse them with fresh water. Do not allow the soda solution to enter the battery. Add distilled water to the electrolyte, if necessary, and fully charge the battery. Store the battery in a cool (never below 32 °F or 0 °C) dry place. Keep the battery fully charged and check the level and the specific gravity of the electrolyte regularly.

24. Insert heavy paper strips between the pulleys and belts to prevent sticking.

25. Seal all of the openings in the engine, including the exhaust outlet, with moisture resistant tape. Use cardboard, plywood or metal covers where practical.

26. Clean and dry the exterior painted surfaces of the engine. Spray the surfaces with a suitable liquid automobile body wax, a synthetic resin varnish or a rust preventive compound.

27. Cover the engine with a good weather-resistant tarpaulin or other cover if it must be stored outdoors. A clear plastic cover is recommended for indoor storage.

The stored engine should be inspected periodically. If there are any indications of rust or corrosion, corrective steps must be taken to prevent damage to the engine parts. Perform a complete inspection at the end of one year and apply additional treatment as required.

PROCEDURE FOR RESTORING AN ENGINE TO SERVICE WHICH HAS BEEN IN EXTENDED STORAGE

1. Reinstall the valve rocker covers.

2. Remove the covers and tape from all of the openings of the engine, fuel tank and electrical equipment. *Do not overlook the exhaust outlet.*

3. Wash the exterior of the engine with fuel oil to remove the rust preventive.

4. Remove the rust preventive from the flywheel.

5. Remove the paper strips from between the pulleys and the belts.

6. Remove the drain plug and drain the preservative oil from the crankcase. Reinstall the drain plug. Then refer to *Lubrication System* in the *Operating Instructions* and fill the crankcase to the proper level with the recommended grade of lubricating oil.

7. Fill the fuel tank with the fuel specified under *Diesel Fuel Oil Specifications.*

8. Close all of the drain cocks and fill the engine cooling system with clean soft water and a rust inhibitor. If the engine is to be exposed to freezing temperatures, add a high boiling point type antifreeze solution to the cooling system (the antifreeze contains a rust inhibitor).

9. Install and connect the battery.

10. Service the air cleaner as outlined under *Air System.*

11. POWER GENERATOR

Prepare the generator for starting as outlined under *Operating Instructions.*

12. MARINE GEAR

Check the Marine gear; refill it to the proper level, as necessary, with the correct grade of lubricating oil.

13. TORQMATIC CONVERTER

a. Remove the tape from the breather and all of the openings.

b. Remove all of the preservative grease with a suitable solvent.

c. Start the engine and operate the unit until the temperature reaches 150 °F (66 °C). Drain the preservative oil and remove the filter. Start the engine and stall the converter for twenty seconds at 1000 rpm to scavenge the oil from the converter.

CAUTION: A Torqmatic converter containing preservative oil should only be operated enough to bring the oil temperature up to 150 °F (66 °C).

d. Install the drain plug and a new filter element.

e. Refill the converter with the oil that is recommended under *Lubrication and Preventive Maintenance.*

14. POWER TAKE-OFF

Remove the inspection hole cover and inspect the clutch release lever and link pins and the bearing ends of the clutch release shaft. Apply engine oil sparingly, if necessary, to these areas.

15. HYDROSTARTER

a. Open the relief valve on the side of the hand pump and release the pressure in the system.

b. Refer to the filling and purging procedures outlined in *Hydraulic Starting System.* Then drain, refill and purge the hydrostarter system.

16. TURBOCHARGER

a. Thoroughly clean the area around the turbocharger air inlet tube and the oil inlet line.

b. Disconnect the air inlet tube from the compressor housing.

c. Disconnect the oil inlet line from the top of the center housing.

d. Pour approximately four ounces of lubricating oil in the oil inlet opening of the center housing. Reach in through the air inlet opening in the compressor housing and turn the rotating assembly by hand to coat the bearings, thrust ring and thrust washer with oil. Then fill the oil inlet line with engine oil.

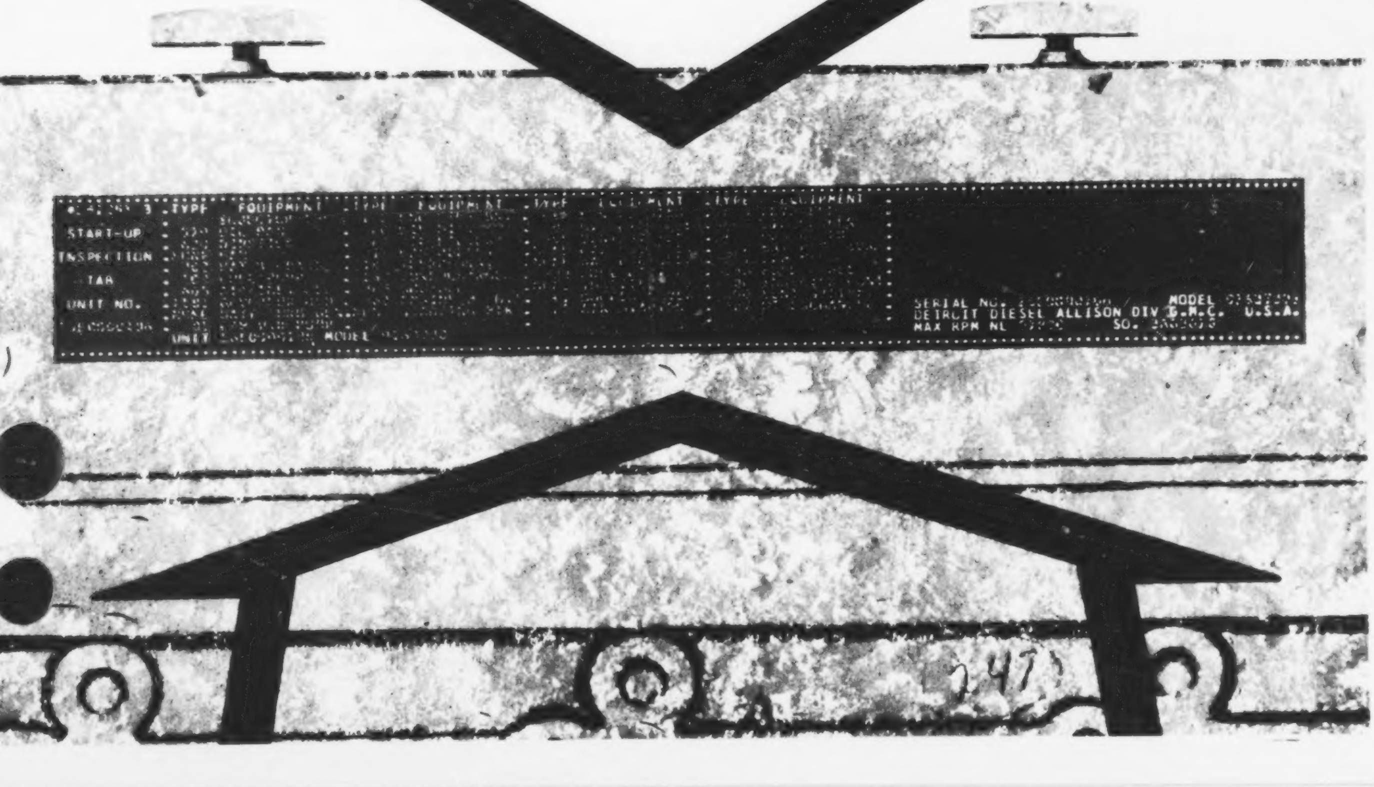
e. Connect the oil inlet line to the top of the center housing. Then connect the air inlet tube to the compressor housing.

17. After all of the preparations have been completed, start the engine. The small amount of rust preventive compound which remains in the fuel system will cause a smoky exhaust for a few minutes.

NOTE: Before subjecting the engine to a load or high speed, it is advisable to check the engine tune-up.

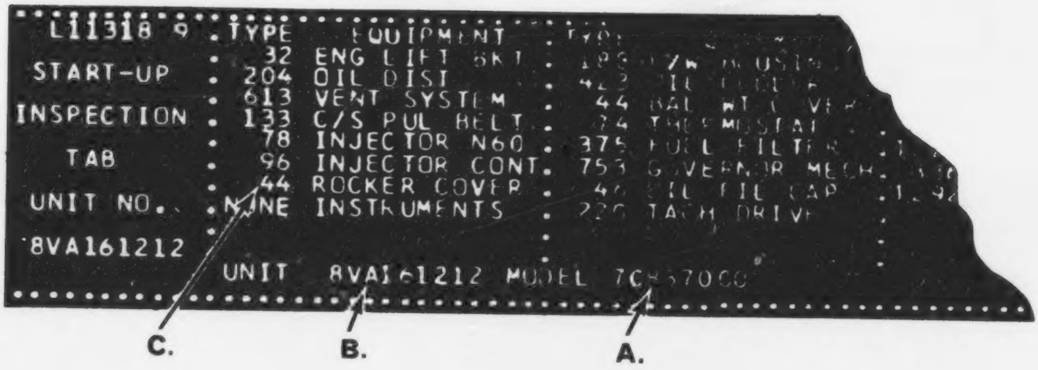
BUILT-IN

PARTS BOOK
for
DETROIT DIESEL ENGINES


TYPE
EQUIPMENT
TYPE
EQUIPMENT
TYPE
EQUIPMENT
TYPE
EQUIPMENT
START-UP
INSPECTION
TAB
UNIT NO.
UNIT
MODEL
SERIAL NO.
MODEL
DETROIT DIESEL ALLISON DIV G.M.C. U.S.A.
MAX RPM NL
SO.

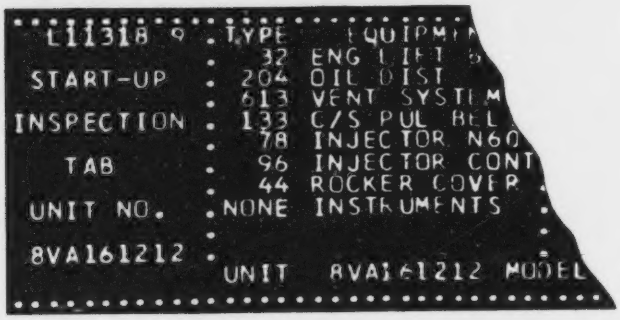
Progress in industry comes at a rapid pace. In order for the engine manufacturer to keep pace with progress he needs a versatile product for the many models and arrangements of accessories and mounting parts needed to suit a variety of equipment. In addition, engine refinements and improvements are constantly being introduced. All of this dynamic action must be documented so that the equipment can be serviced if and when it's needed. It is fully documented in the manufacturer's plant and in dealer Parts Departments with Master Files and adequate supporting records. But, what about YOU the user of this equipment? You have neither the time nor the inclination to ferret out specific part number data. What is the answer?—It is Detroit Diesel's exclusive BUILT-IN PARTS BOOK which is furnished with each engine. It takes the form of an "Option Plate" mounted on the rocker cover of the engine. With it, ordering parts becomes as simple as A, B, C. You have merely to provide the Dealer with . . .

A. The "Model" number **B.** The "UNIT" number **C.** The "TYPE" number


L11318 9
TYPE
EQUIPMENT
START-UP
INSPECTION
TAB
UNIT NO..
8VA161212
32 ENG LIFT BKT
204 OIL DIST
613 VENT SYSTEM
133 C/S PUL BELT
78 INJECTOR N60
96 INJECTOR CONT.
44 ROCKER COVER
NONE INSTRUMENTS
44 BAL WT COVER
375 FUEL FILTER
753 GOVERNOR MECH.
226 TACH DRIVE
UNIT 8VA161212 MODEL 7C
C.
B.
A.

From that much information, the dealer with his complete records on all engine models, can completely interpret your parts requirements.

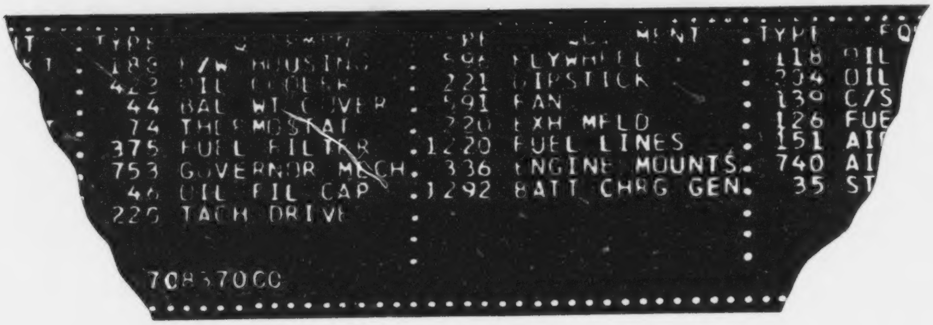
What is this "built-in" book? It is a photo etched aluminum plate that fits into a holding channel on the engine rocker cover.



L11318 9
START-UP
INSPECTION
TAB
UNIT NO.
8VA161212

TYPE EQUIPM
32 ENG LIFT
204 OIL DIST
613 VENT SYSTEM
133 C/S PUL BEL
78 INJECTOR N60
96 INJECTOR CONT
44 ROCKER COVER
NONE INSTRUMENTS
UNIT 8VA161212 MODEL

ON THE LEFT SIDE of the plate is the Start-up Inspection Tab which is removed by the dealer when he has completed the inspection.

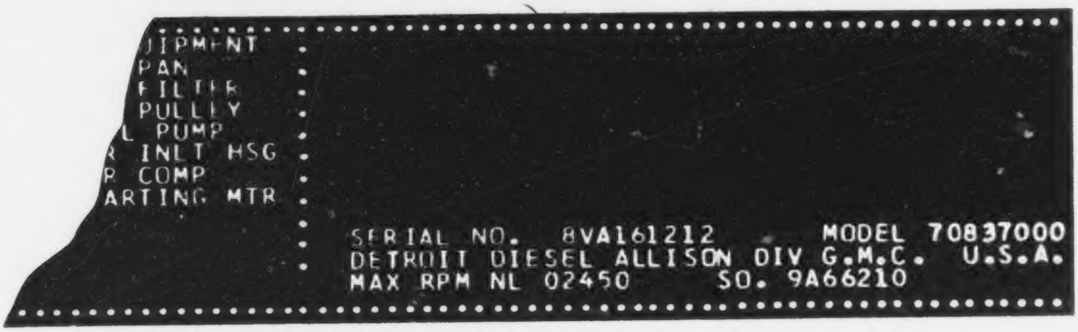


TYPE
183 F/W HOUSING
423 OIL COOLER
44 BAL WT COVER
74 THERMOSTAT
375 FUEL FILTER
753 GOVERNOR MECH
46 OIL FIL CAP
220 TACH DRIVE
70837000

MENT
221 DIPSTICK
591 FAN
220 EXH MFLD
1220 FUEL LINES
336 ENGINE MOUNTS
1292 BATT CHRG GEN

TYPE
118 OIL
204 OIL
139 C/S
126 FUE
151 AI
740 AI
35 ST

NEXT is the type number and the equipment description. On the left is the type number. The type number designates all service parts applicable to the equipment. On the right is a brief description of the equipment.

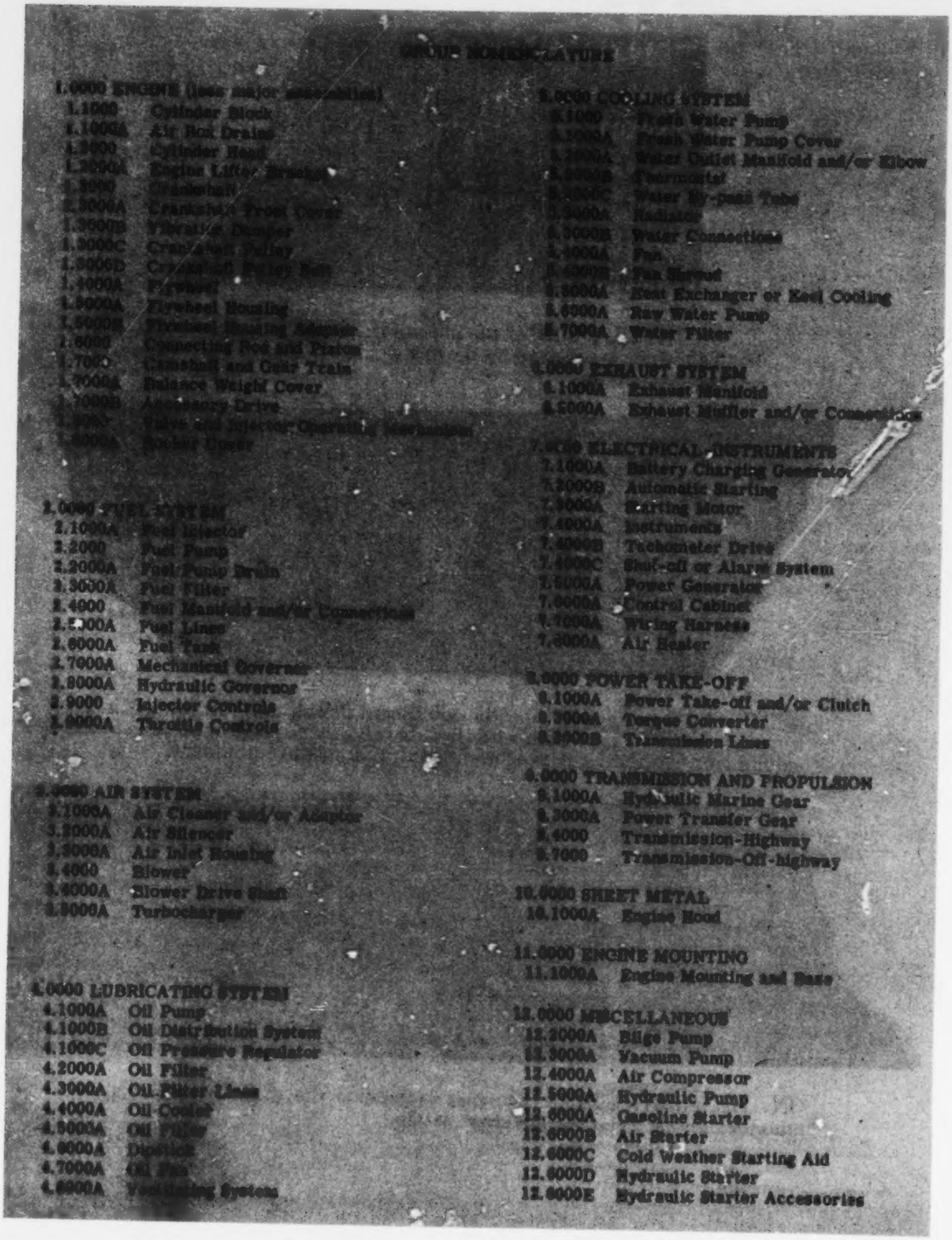


JIPMENT
PAN
FILTER
PULLEY
L PUMP
R INLT HSG
R COMP
ARTING MTR

SERIAL NO. 8VA161212 MODEL 70837000
DETROIT DIESEL ALLISON DIV G.M.C. U.S.A.
MAX RPM NL 02450 SO. 9A66210

ON THE RIGHT SIDE of the plate is shown the model number, serial number and the related governor setting.

All engine components are divided into groups of functionally related parts. A complete listing of the twelve major groups and their many sub-groups is shown below.

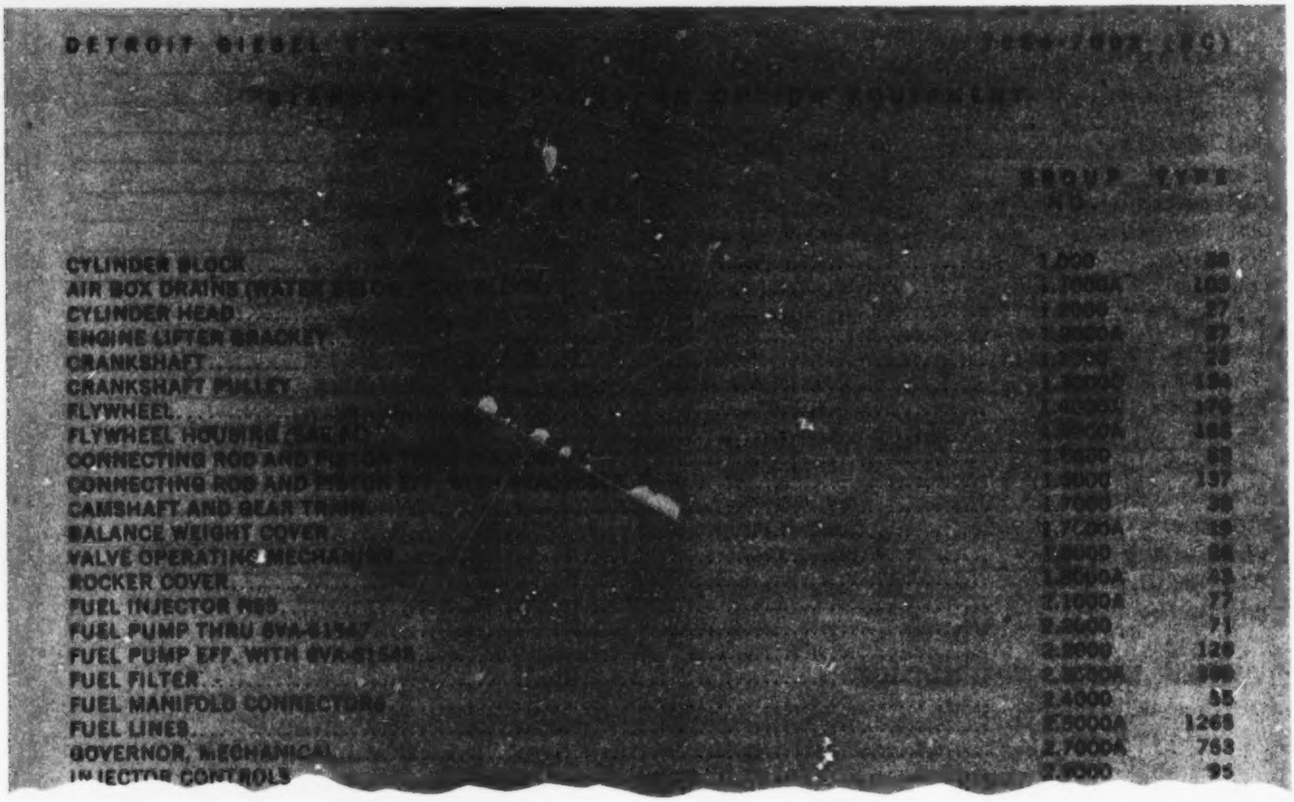


GROUP NOMENCLATURE

1.0000	**ENGINE (less major assemblies)**
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adapter
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover
2.0000	**FUEL SYSTEM**
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.5000A	Fuel Lines
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls
3.0000	**AIR SYSTEM**
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.5000A	Turbocharger
4.0000	**LUBRICATING SYSTEM**
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System
5.0000	**COOLING SYSTEM**
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter
6.0000	**EXHAUST SYSTEM**
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections
7.0000	**ELECTRICAL-INSTRUMENTS**
7.1000A	Battery Charging Generator
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off or Alarm System
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
8.0000	**POWER TAKE-OFF**
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines
9.0000	**TRANSMISSION AND PROPULSION**
9.1000A	Hydraulic Marine Gear
9.3000A	Power Transfer Gear
9.4000	Transmission-Highway
9.7000	Transmission-Off-highway
10.0000	**SHEET METAL**
10.1000A	Engine Hood
11.0000	**ENGINE MOUNTING**
11.1000A	Engine Mounting and Base
12.0000	**MISCELLANEOUS**
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories

Within each of these sub-groups, various designs of similar equipment are categorized as "Types" and identified by a Type Number.

The Distributor/Dealer has an Index for each engine model. The Index lists all of the "Standard" and "Standard Option" equipment for that model.



DETROIT DIESEL [illegible]

[illegible]

	GROUP NO.	TYPE
CYLINDER BLOCK	1.000	[illegible]
AIR BOX DRAINS (WATER [illegible]	1.1000A	103
CYLINDER HEAD	1.2000	27
ENGINE LIFTER BRACKET	[illegible]	87
CRANKSHAFT	[illegible]	[illegible]
CRANKSHAFT PULLEY	[illegible]	[illegible]
FLYWHEEL	[illegible]	[illegible]
FLYWHEEL HOUSING [illegible]	[illegible]	[illegible]
CONNECTING ROD AND [illegible]	1.6000	[illegible]
CONNECTING ROD AND PISTON [illegible]	1.6000	137
CAMSHAFT AND GEAR TRAIN	1.7000	[illegible]
BALANCE WEIGHT COVER	1.7000A	[illegible]
VALVE OPERATING MECHANISM	1.8000	[illegible]
ROCKER COVER	1.8000A	43
FUEL INJECTOR [illegible]	2.1000A	77
FUEL PUMP THRU 6VA-[illegible]	2.2000	71
FUEL PUMP EFF. WITH 6VA-[illegible]	2.2000	128
FUEL FILTER	2.3000A	[illegible]
FUEL MANIFOLD CONNECTORS	2.4000	55
FUEL LINES	2.5000A	1268
GOVERNOR, MECHANICAL	2.7000A	753
INJECTOR CONTROLS	[illegible]	95

NOTE The Distributor/Dealer uses his model index to interpret the standard equipment. The plate, therefore, lists only the non-standard or choice items.

So, from the plate, give the dealer the

A—Model No.____________
B—Unit No. ____________
***C—Type No.** ____________

*(If not shown, indicate "NONE". The dealer knows the "standard" for the model).

FOR READY REFERENCE, Transfer the information on the Option Plate to this record.

MODEL NO.____________________ **UNIT NO.**____________________

EQUIPMENT	TYPE	EQUIPMENT	TYPE	EQUIPMENT	TYPE
Engine Base		Water Bypass Tube		Battery Chrg. Generator	
Engine Lifter Brkt.		Thermostat		Starter	
Flywheel Housing		Water Filter		Hyd. Starter Acces.	
Vibration Damper		Exhaust Manifold		Starting Aid	
Flywheel		Air Cleaner or Silencer		Marine Gear	
Flywheel Hsg. Adptr.		Fuel Pump		Torque Converter	
Oil Pan		Injector		Torque Converter Lines	
Oil Pump		Blower		Muffler & Conn.	
Oil Distribution		Blower Drive Shaft		Engine Hood	
Dipstick		Fuel Filter		Wiring Harness	
Oil Pan Drain Tube		Fuel Lines		Instruments	
Oil Filler Tube or Cap		Air Inlet Housing		Tach. Drive	
Oil Cooler		Alarm or Shutoff		Radiator	
Oil Filter		Overspeed Governor		Heat Ex. or Keel Cooling	
Oil Lines		Throttle Controls		Raw Water Pump	
Ventilating System		Injector Controls		Power Generator	
Crankshaft Cover		Governor Mech or Hyd		Control Cabinet	
Balance Wgt. Cover		Engine Mounts		Cylinder Head	
Fan		Power Take-off		Conn Rod & Piston	
Crankshaft Pulley		Hydraulic Pump		Valve Mechanism	
Crankshaft Pulley Belt		Air Compressor		Fuel Manifold Conn	
Fan Shroud		Camshaft & Gear Train			
Water Connections		Rocker Cover			
Water Pump Cover		Accessory Drive			
Water Manifold					

OTHER USEFUL INFORMATION:

Each fuel and lube oil filter on your engine has a decal giving the service package part number for the element. It is advisable to have your own personal record of these part numbers by filling in the chart provided below:

TYPE	LOCATION	PACKAGE PART NO.
Fuel Strainer		
Fuel Filter		
Lube Oil Filter Full-Flo		
Lube Oil Filter By-Pass*		

*Not Standard

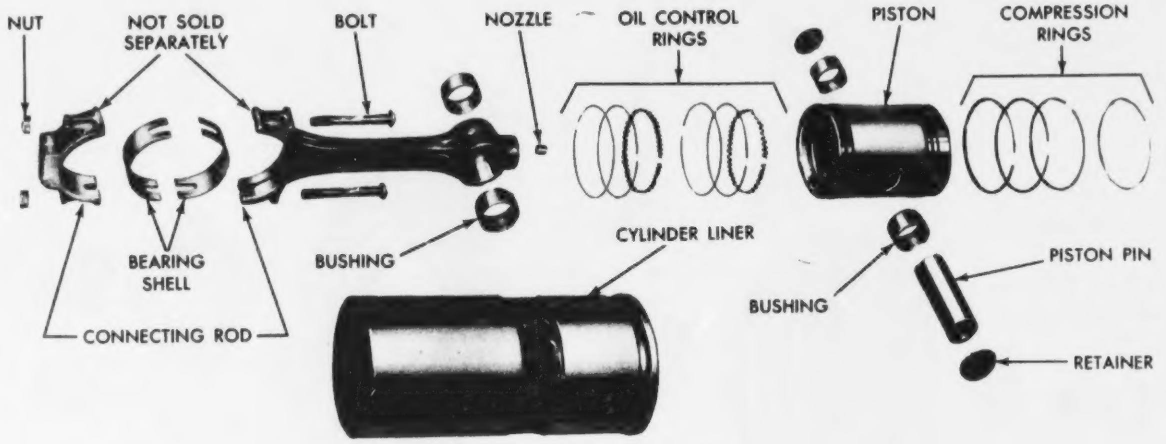
AIR CLEANER

If dry-type, indicate make and number of filter element:

____

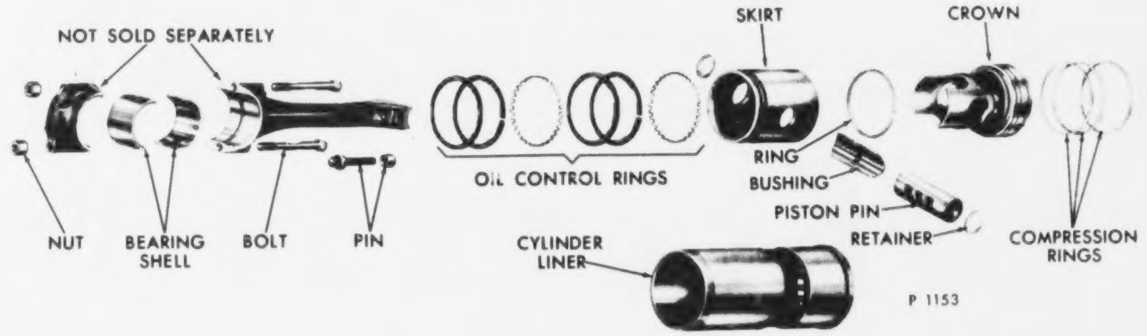
____

Wet type, indicate capacity__________qts.

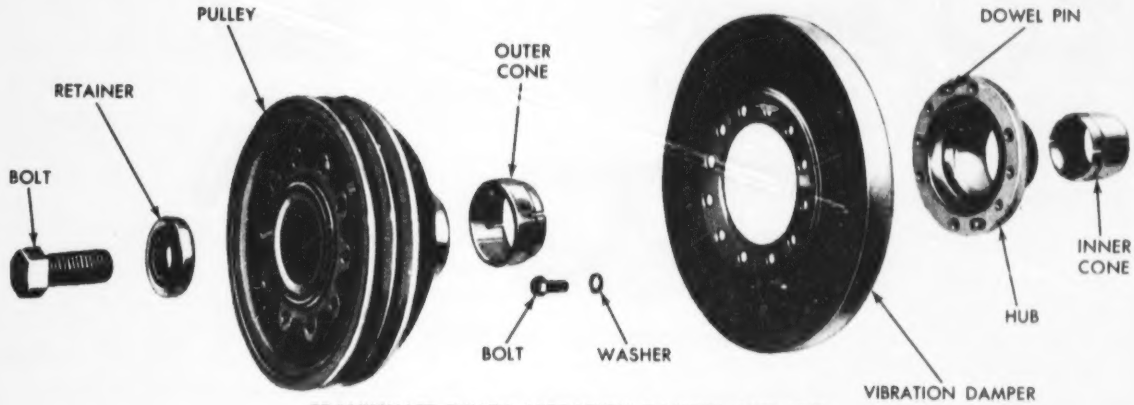

NUT
NOT SOLD SEPARATELY
BOLT
NOZZLE
OIL CONTROL RINGS
PISTON
COMPRESSION RINGS
BEARING SHELL
BUSHING
CYLINDER LINER
PISTON PIN
BUSHING
RETAINER
CONNECTING ROD

CONNECTING ROD AND PISTON

P 607B

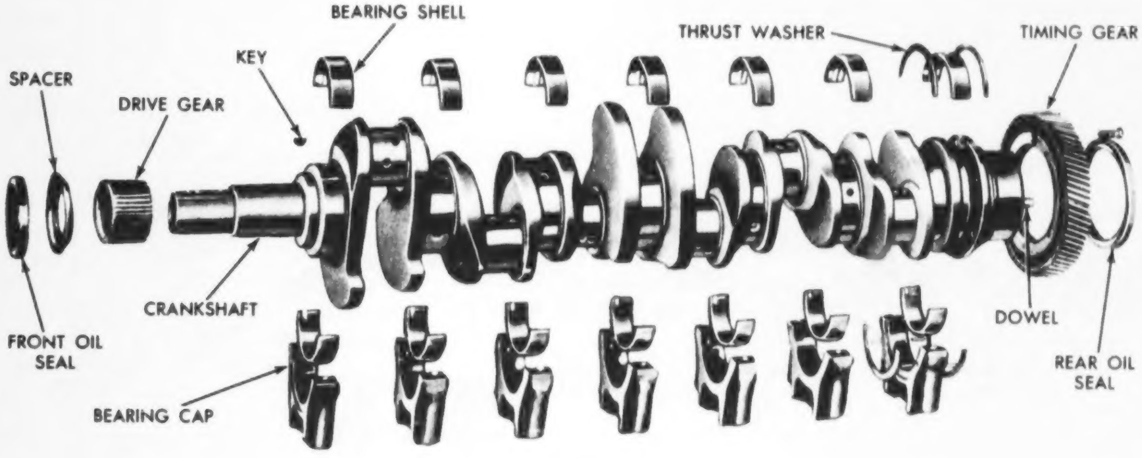

NOT SOLD SEPARATELY
SKIRT
CROWN
RING
BUSHING
PISTON PIN
RETAINER
OIL CONTROL RINGS
NUT
BEARING SHELL
BOLT
PIN
CYLINDER LINER
COMPRESSION RINGS
P 1153

CONNECTING ROD AND CROSS-HEAD PISTON


PULLEY
OUTER CONE
DOWEL PIN
RETAINER
BOLT
INNER CONE
HUB
BOLT
WASHER
VIBRATION DAMPER

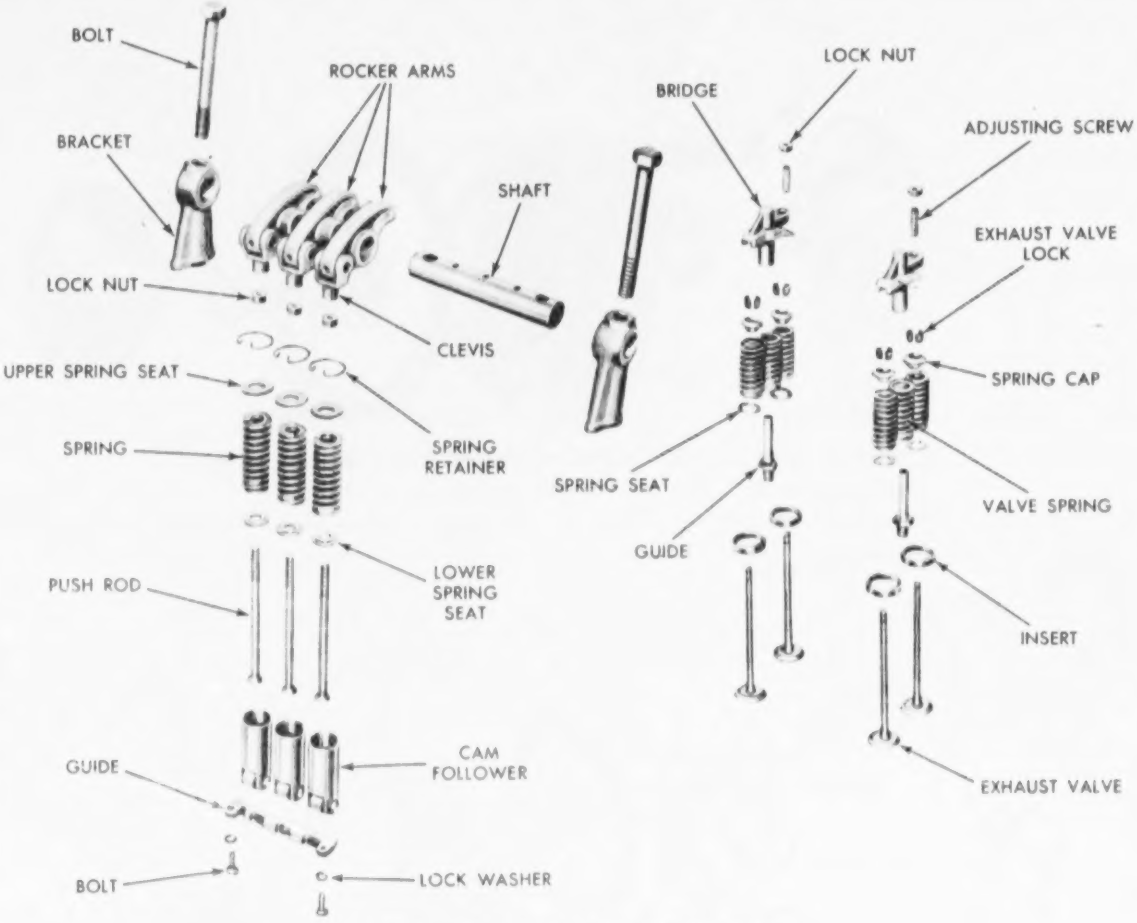
CRANKSHAFT PULLEY, VIBRATION DAMPER AND HUB

P 607A


BEARING SHELL
THRUST WASHER
TIMING GEAR
KEY
SPACER
DRIVE GEAR
CRANKSHAFT
DOWEL
FRONT OIL SEAL
REAR OIL SEAL
BEARING CAP

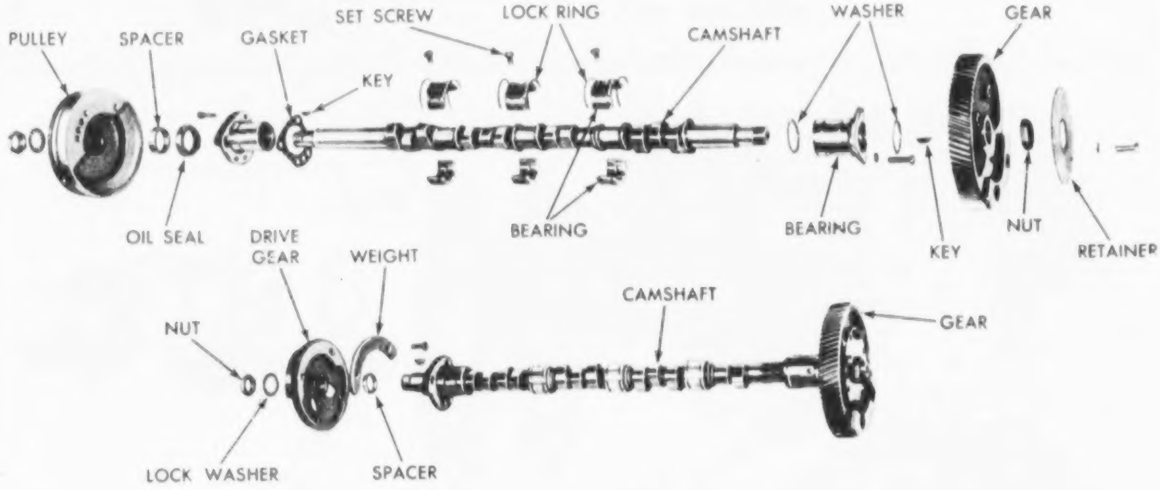
CRANKSHAFT

P 607


BOLT
ROCKER ARMS
BRACKET
SHAFT
LOCK NUT
CLEVIS
UPPER SPRING SEAT
SPRING
SPRING RETAINER
PUSH ROD
LOWER SPRING SEAT
CAM FOLLOWER
GUIDE
BOLT
LOCK WASHER
LOCK NUT
BRIDGE
ADJUSTING SCREW
EXHAUST VALVE LOCK
SPRING CAP
SPRING SEAT
GUIDE
VALVE SPRING
INSERT
EXHAUST VALVE

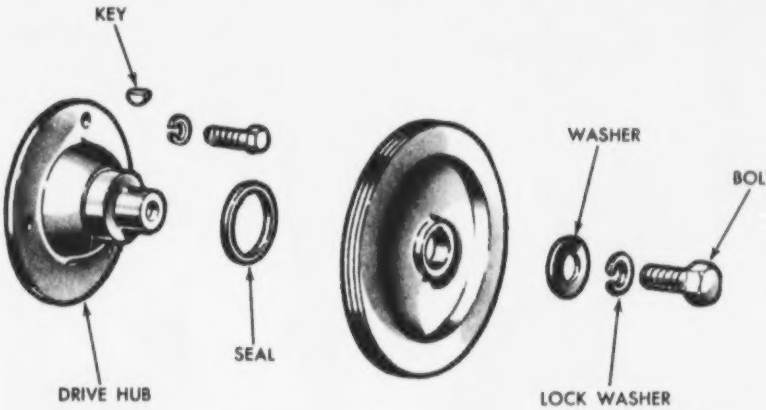
VALVE OPERATING MECHANISM (4 VALVE)

P 600A


PULLEY
SPACER
GASKET
SET SCREW
KEY
LOCK RING
CAMSHAFT
WASHER
GEAR
OIL SEAL
BEARING
BEARING
KEY
NUT
RETAINER
DRIVE GEAR
WEIGHT
NUT
CAMSHAFT
GEAR
LOCK WASHER
SPACER

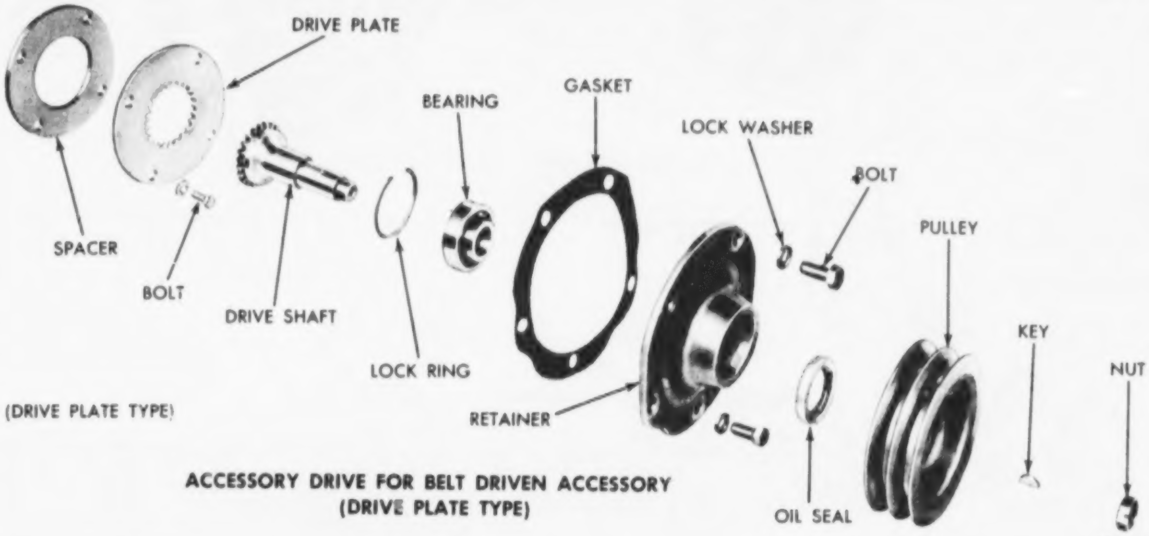
CAMSHAFT AND GEARS

P 600


KEY
WASHER
BOLT
DRIVE HUB
SEAL
LOCK WASHER

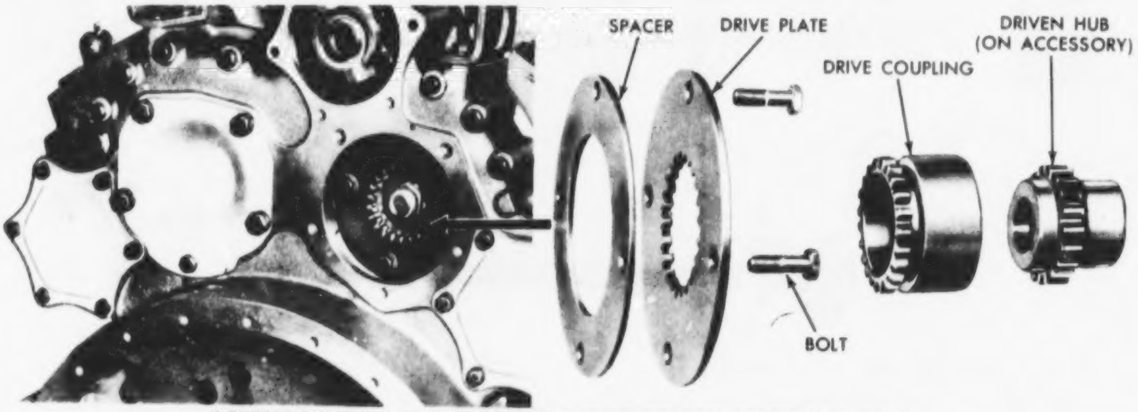
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (FRONT MOUNTED TYPE)

P 609B


DRIVE PLATE
BEARING
GASKET
LOCK WASHER
BOLT
PULLEY
SPACER
BOLT
DRIVE SHAFT
KEY
NUT
LOCK RING
(DRIVE PLATE TYPE)
RETAINER
OIL SEAL

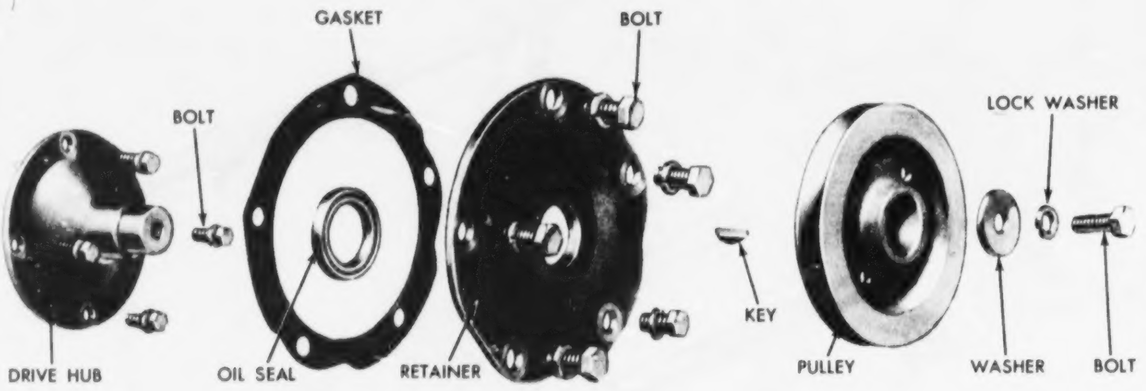
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY
(DRIVE PLATE TYPE)

P 609A


SPACER
DRIVE PLATE
DRIVEN HUB (ON ACCESSORY)
DRIVE COUPLING
BOLT

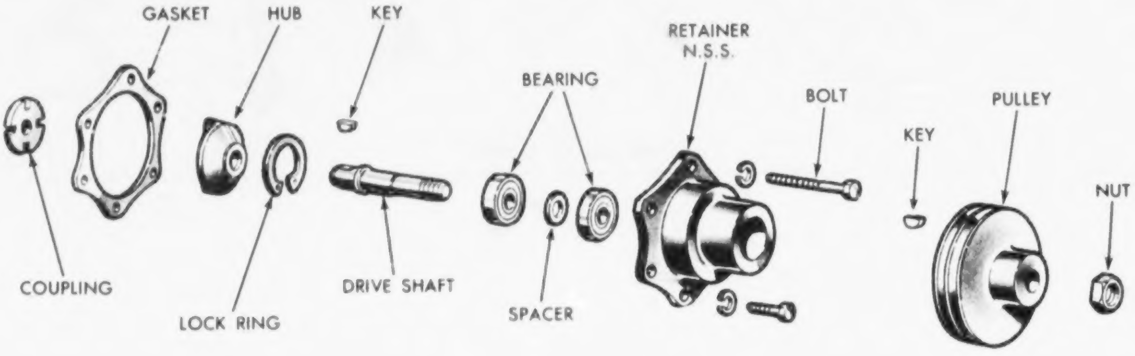
ACCESSORY DRIVE FOR DIRECT DRIVEN ACCESSORY (CAMSHAFT GEAR)

P 609


GASKET
BOLT
BOLT
LOCK WASHER
KEY
DRIVE HUB
OIL SEAL
RETAINER
PULLEY
WASHER
BOLT

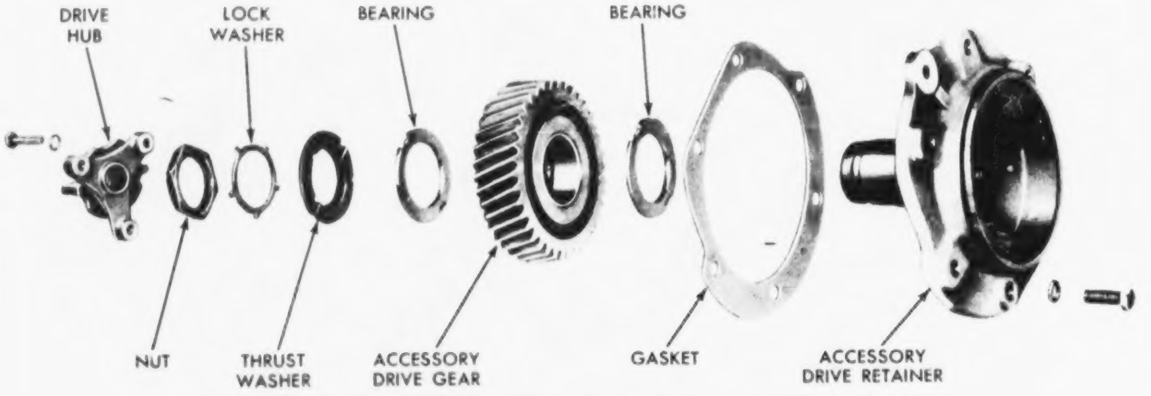
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE HUB TYPE)

P 603B


GASKET
HUB
KEY
RETAINER N.S.S.
BEARING
BOLT
PULLEY
KEY
NUT
COUPLING
LOCK RING
DRIVE SHAFT
SPACER

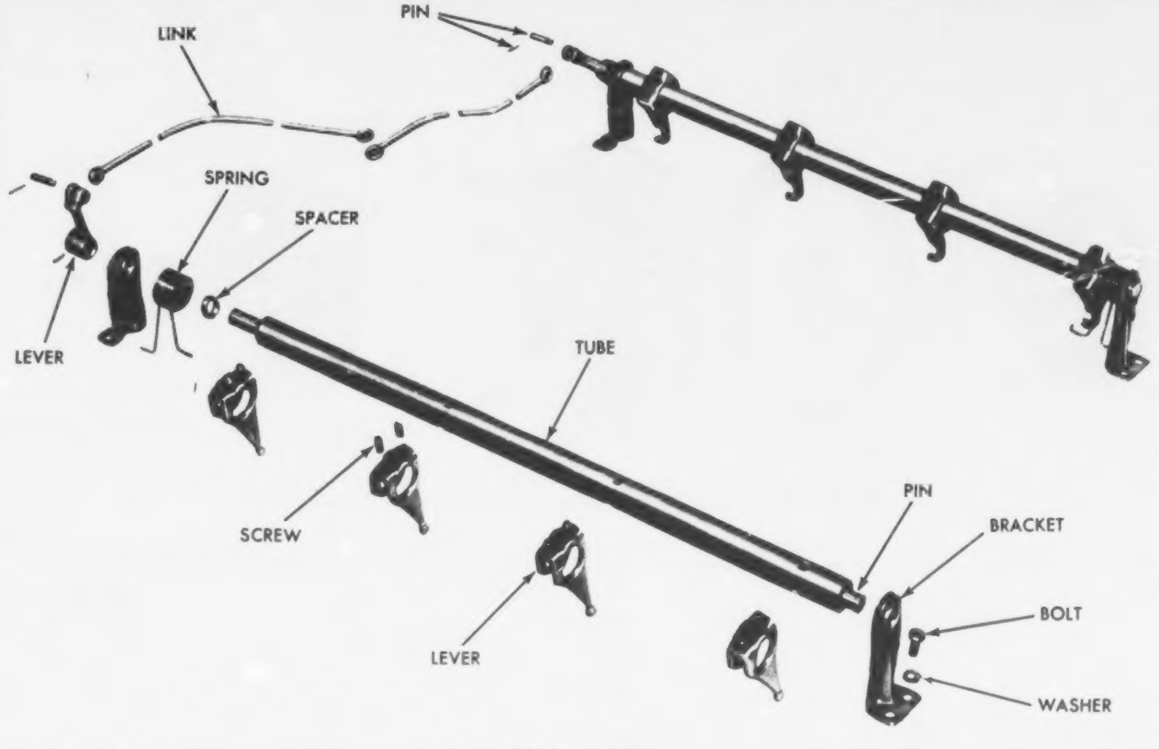
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE DISC COUPLING TYPE)

P 603A


DRIVE HUB
LOCK WASHER
BEARING
BEARING
NUT
THRUST WASHER
ACCESSORY DRIVE GEAR
GASKET
ACCESSORY DRIVE RETAINER

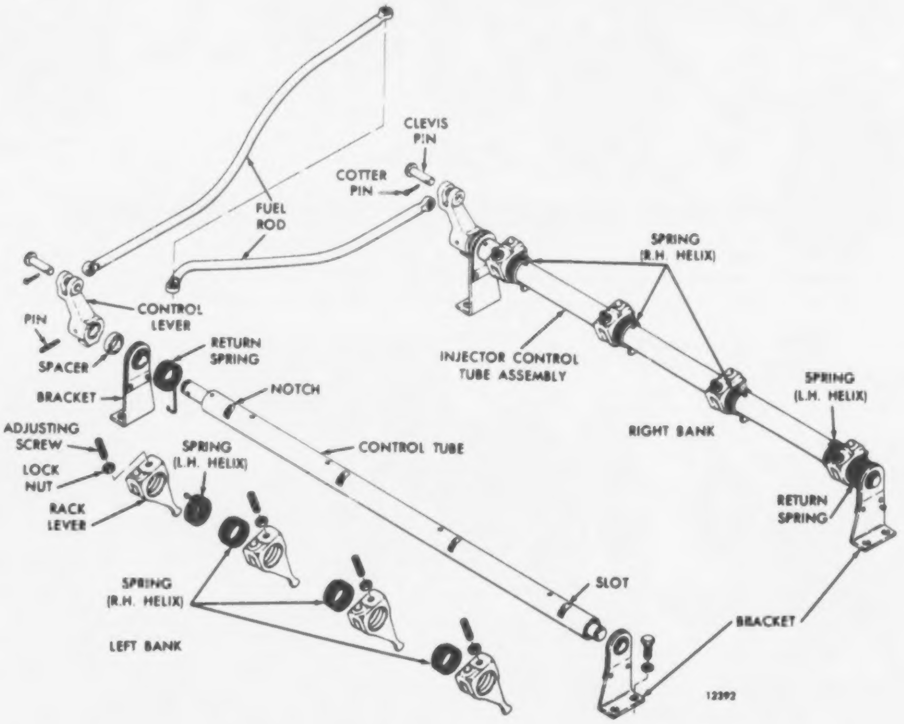
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (ACCESSORY GEAR)

P 603

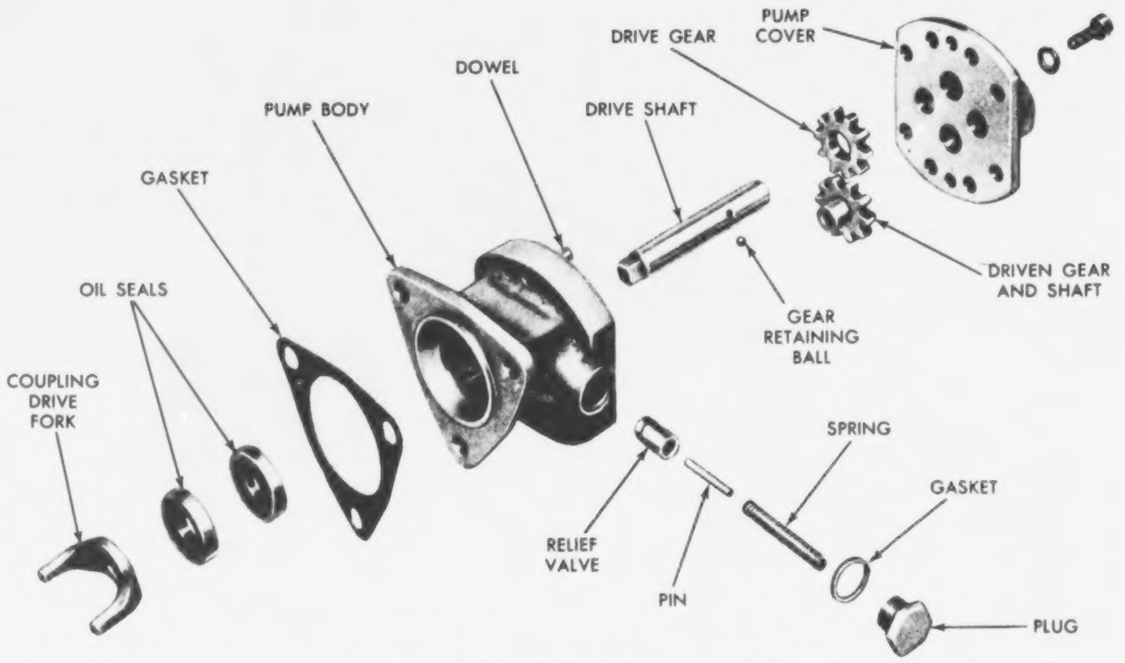

PIN
LINK
SPRING
SPACER
LEVER
TUBE
SCREW
PIN
BRACKET
BOLT
LEVER
WASHER

INJECTOR CONTROLS

P 602A

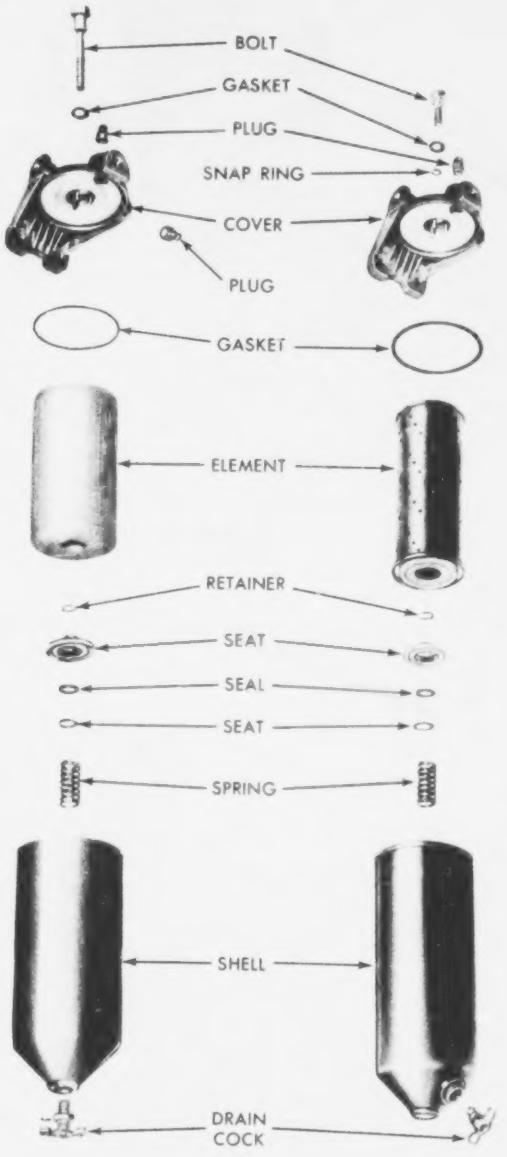

CLEVIS PIN
COTTER PIN
FUEL ROD
SPRING (R.H. HELIX)
CONTROL LEVER
PIN
RETURN SPRING
SPACER
INJECTOR CONTROL TUBE ASSEMBLY
BRACKET
NOTCH
SPRING (L.H. HELIX)
ADJUSTING SCREW
RIGHT BANK
SPRING (L.H. HELIX)
CONTROL TUBE
LOCK NUT
RACK LEVER
RETURN SPRING
SLOT
SPRING (R.H. HELIX)
BRACKET
LEFT BANK
12392

Spring-Loaded Injector Controls


PUMP COVER
DRIVE GEAR
DOWEL
DRIVE SHAFT
PUMP BODY
GASKET
OIL SEALS
DRIVEN GEAR AND SHAFT
GEAR RETAINING BALL
COUPLING DRIVE FORK
SPRING
GASKET
RELIEF VALVE
PIN
PLUG

TYPICAL FUEL PUMP

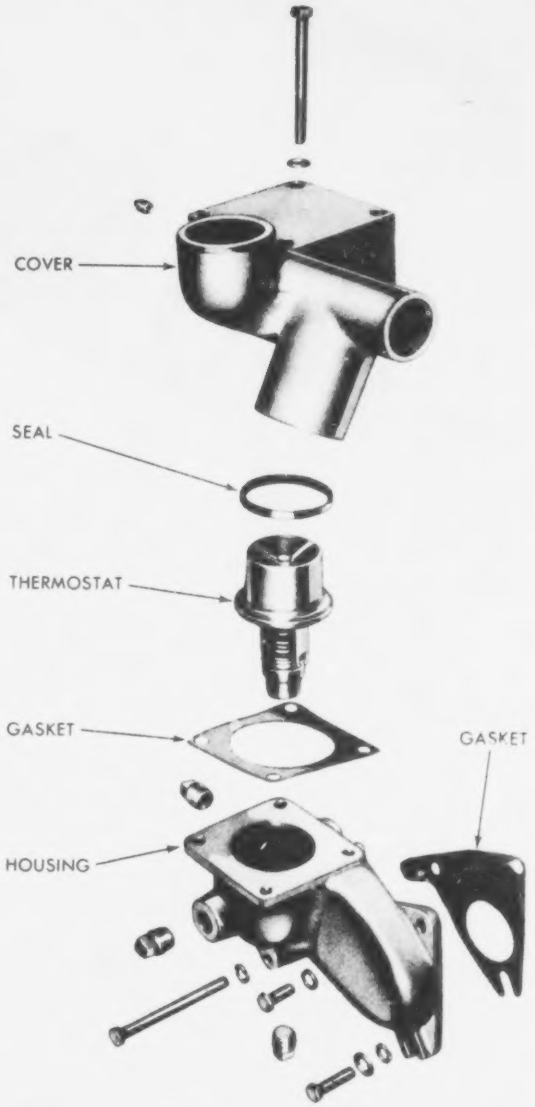
P 602


BOLT
GASKET
PLUG
SNAP RING
COVER
PLUG
GASKET
ELEMENT
RETAINER
SEAT
SEAL
SEAT
SPRING
SHELL
DRAIN COCK

TYPICAL FUEL OIL STRAINER

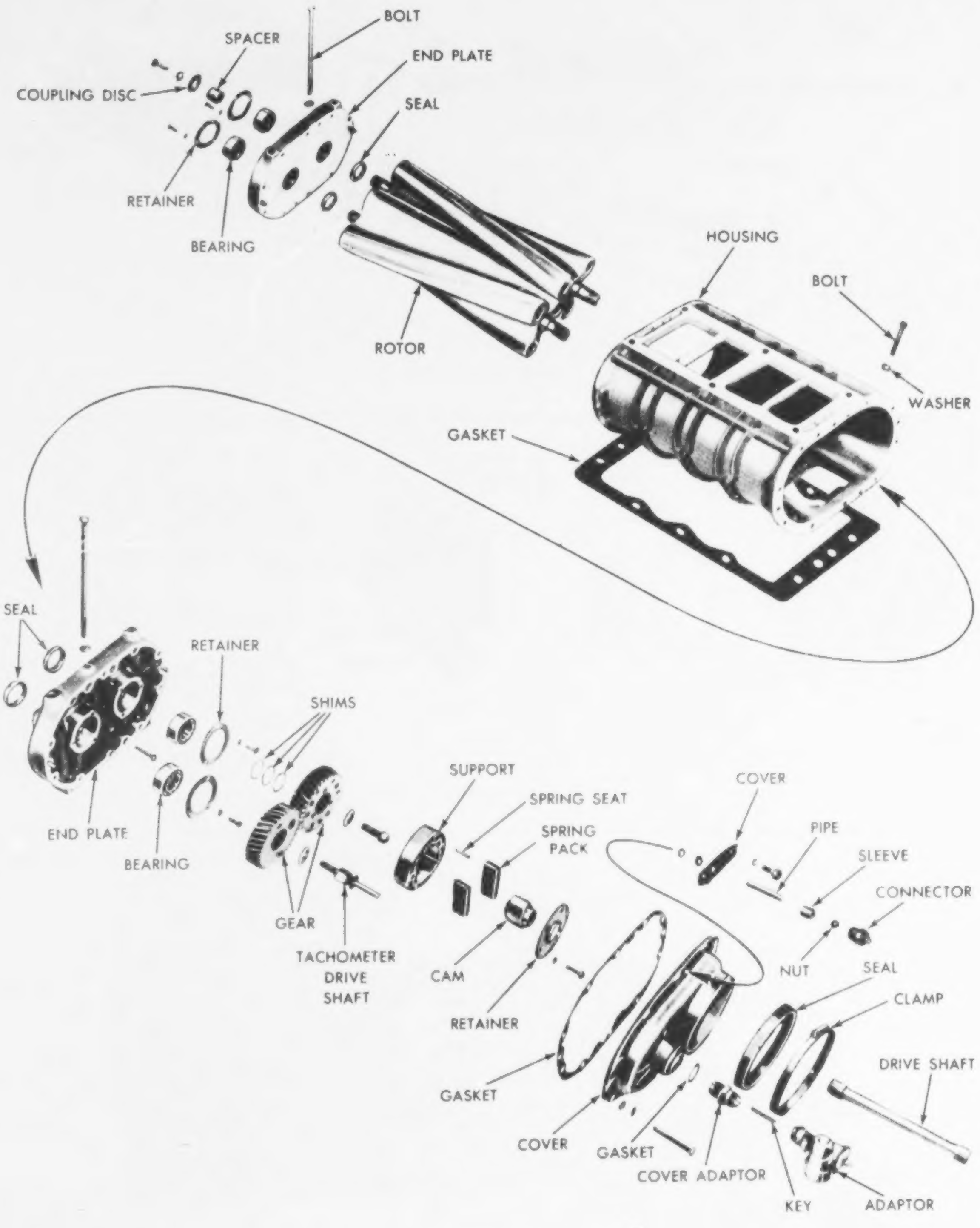
TYPICAL FUEL OIL FILTER

P 601A


COVER
SEAL
THERMOSTAT
GASKET
GASKET
HOUSING

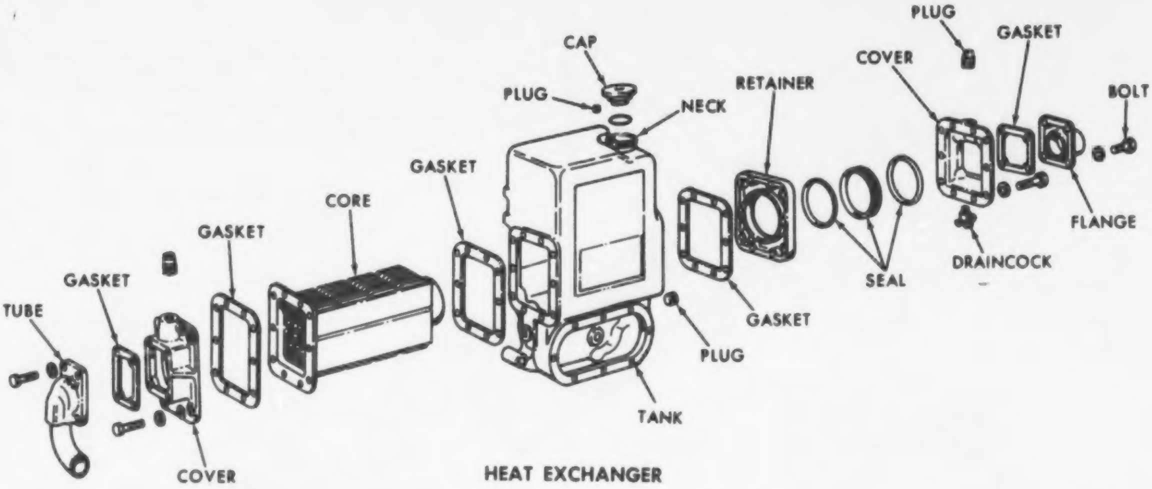
THERMOSTAT HOUSING

P 601


BOLT
SPACER
END PLATE
COUPLING DISC
SEAL
RETAINER
BEARING
HOUSING
BOLT
ROTOR
WASHER
GASKET
SEAL
RETAINER
SHIMS
END PLATE
BEARING
SUPPORT
SPRING SEAT
SPRING PACK
COVER
PIPE
SLEEVE
CONNECTOR
GEAR
TACHOMETER DRIVE SHAFT
CAM
RETAINER
NUT
SEAL
CLAMP
DRIVE SHAFT
GASKET
COVER
GASKET
COVER ADAPTOR
KEY
ADAPTOR

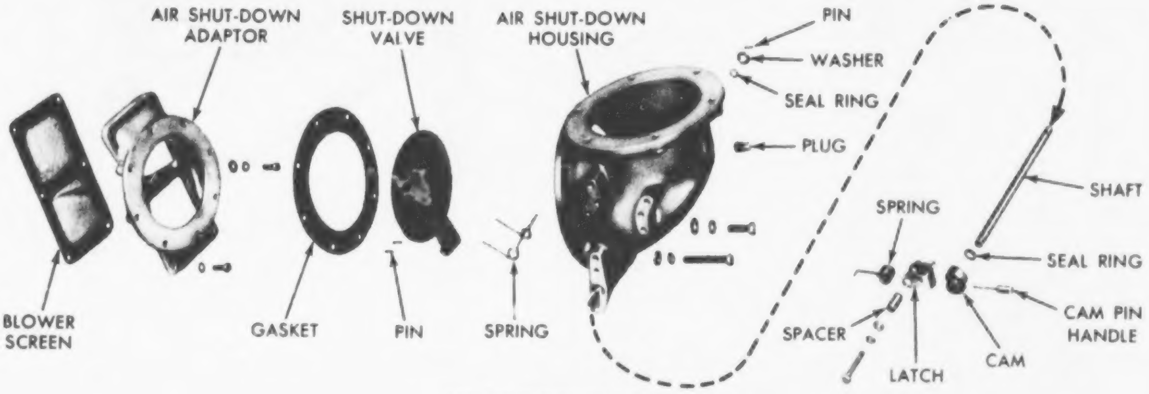
BLOWER

P 606


PLUG
GASKET
CAP
COVER
BOLT
PLUG
NECK
RETAINER
GASKET
CORE
FLANGE
GASKET
DRAINCOCK
SEAL
GASKET
TUBE
GASKET
PLUG
TANK
COVER

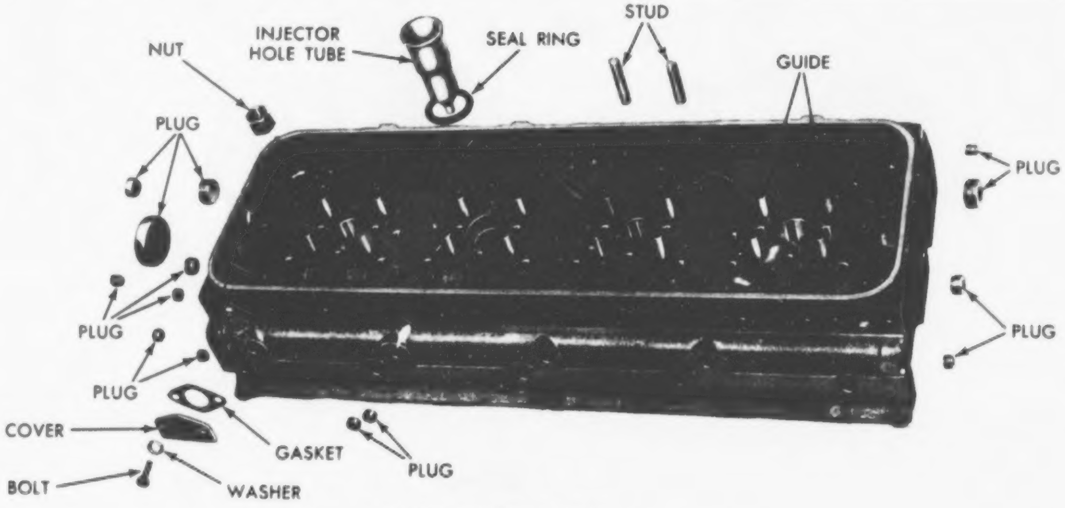
HEAT EXCHANGER

P 1250


AIR SHUT-DOWN ADAPTOR
SHUT-DOWN VALVE
AIR SHUT-DOWN HOUSING
PIN
WASHER
SEAL RING
PLUG
SHAFT
SPRING
SEAL RING
CAM PIN HANDLE
BLOWER SCREEN
GASKET
PIN
SPRING
SPACER
LATCH
CAM

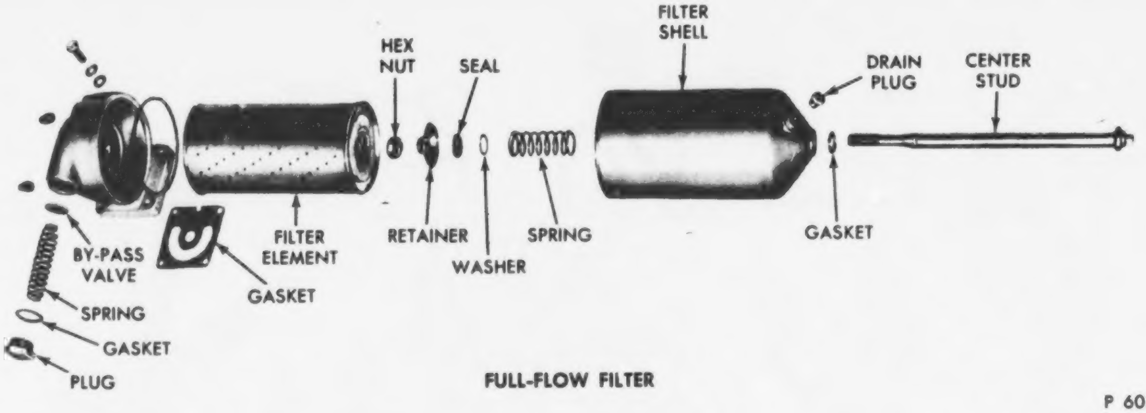
AIR SHUT-DOWN HOUSING

P 604A


STUD
INJECTOR HOLE TUBE
SEAL RING
NUT
GUIDE
PLUG
PLUG
PLUG
PLUG
PLUG
COVER
GASKET
PLUG
BOLT
WASHER

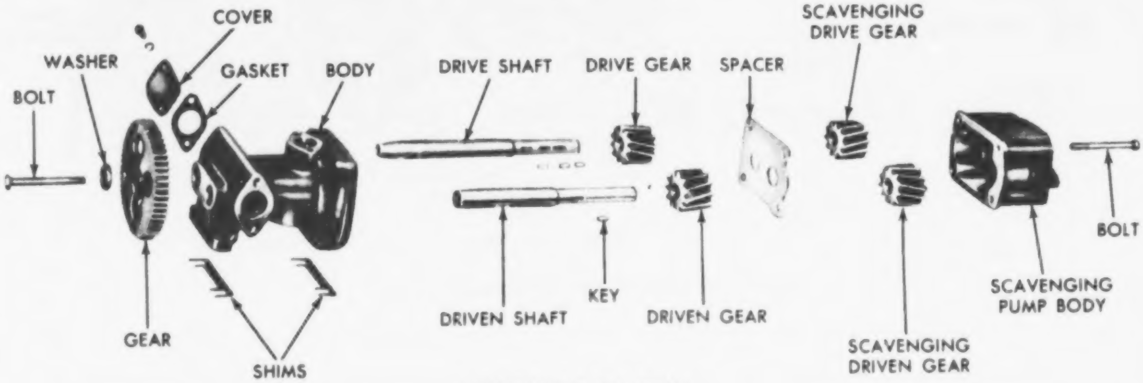
4 VALVE CYLINDER HEAD

P 604


FILTER SHELL
HEX NUT
SEAL
DRAIN PLUG
CENTER STUD
FILTER ELEMENT
RETAINER
SPRING
GASKET
WASHER
BY-PASS VALVE
GASKET
SPRING
GASKET
PLUG

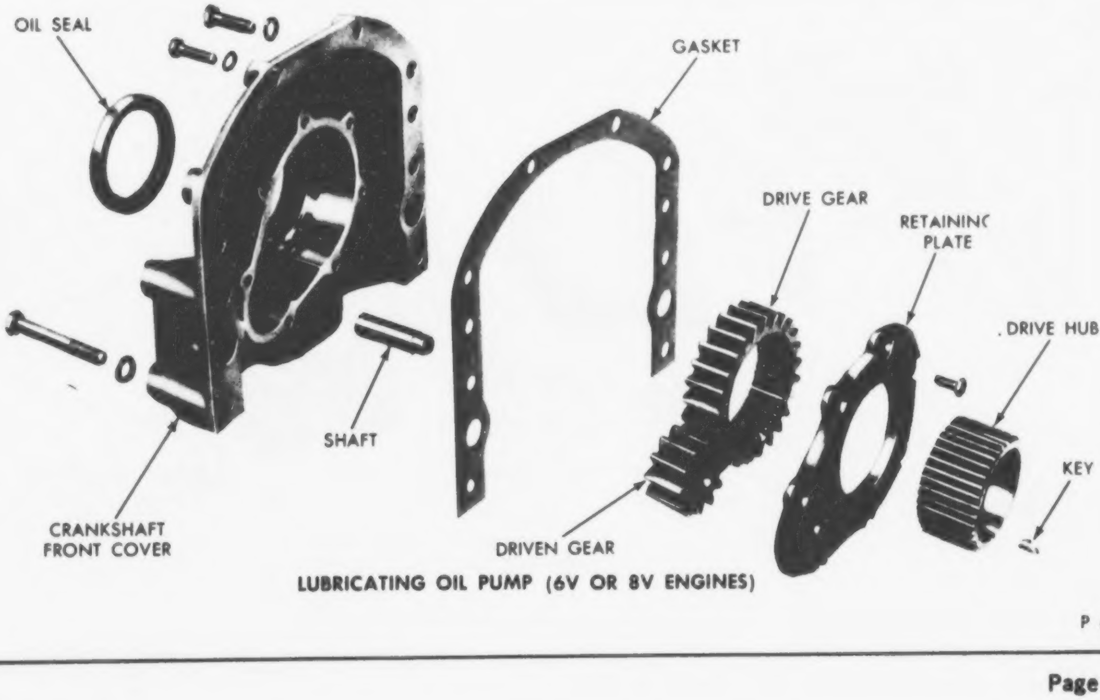
FULL-FLOW FILTER

P 605B


COVER
SCAVENGING DRIVE GEAR
WASHER
GASKET
BODY
DRIVE SHAFT
DRIVE GEAR
SPACER
BOLT
BOLT
KEY
SCAVENGING PUMP BODY
GEAR
DRIVEN SHAFT
DRIVEN GEAR
SCAVENGING DRIVEN GEAR
SHIMS

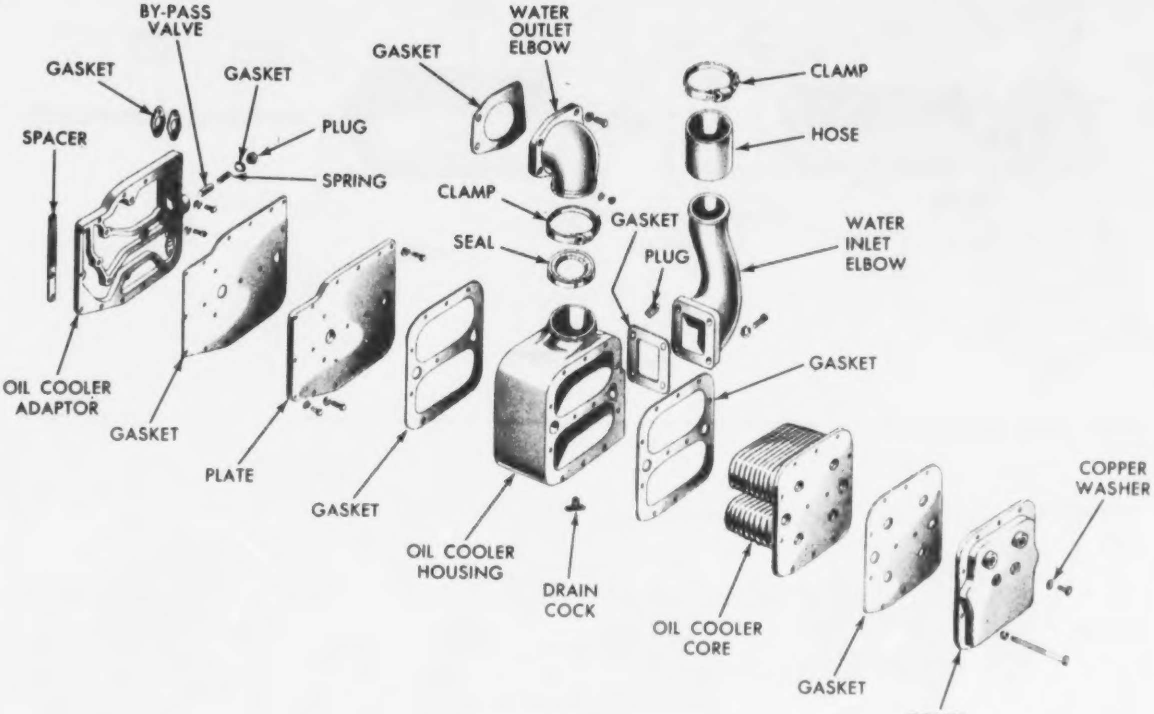
LUBRICATING OIL PUMP

P 605A


OIL SEAL
GASKET
DRIVE GEAR
RETAINING PLATE
DRIVE HUB
KEY
SHAFT
CRANKSHAFT FRONT COVER
DRIVEN GEAR

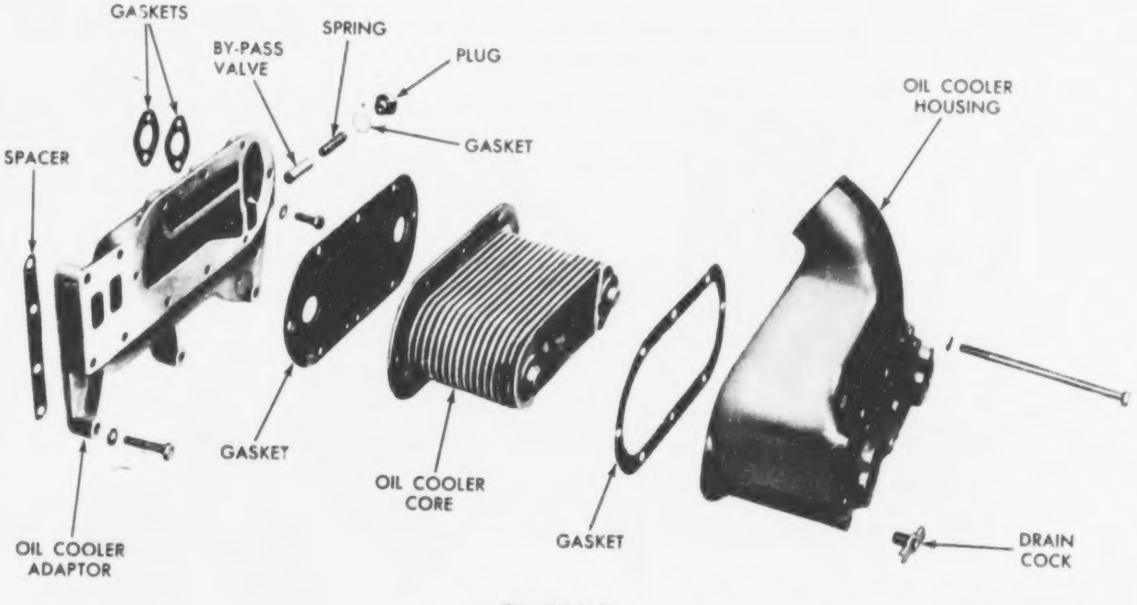
LUBRICATING OIL PUMP (6V OR 8V ENGINES)

P 605


BY-PASS VALVE
WATER OUTLET ELBOW
GASKET
GASKET
GASKET
CLAMP
SPACER
PLUG
HOSE
SPRING
CLAMP
GASKET
WATER INLET ELBOW
SEAL
PLUG
GASKET
OIL COOLER ADAPTOR
GASKET
PLATE
COPPER WASHER
GASKET
OIL COOLER HOUSING
DRAIN COCK
OIL COOLER CORE
GASKET
COVER

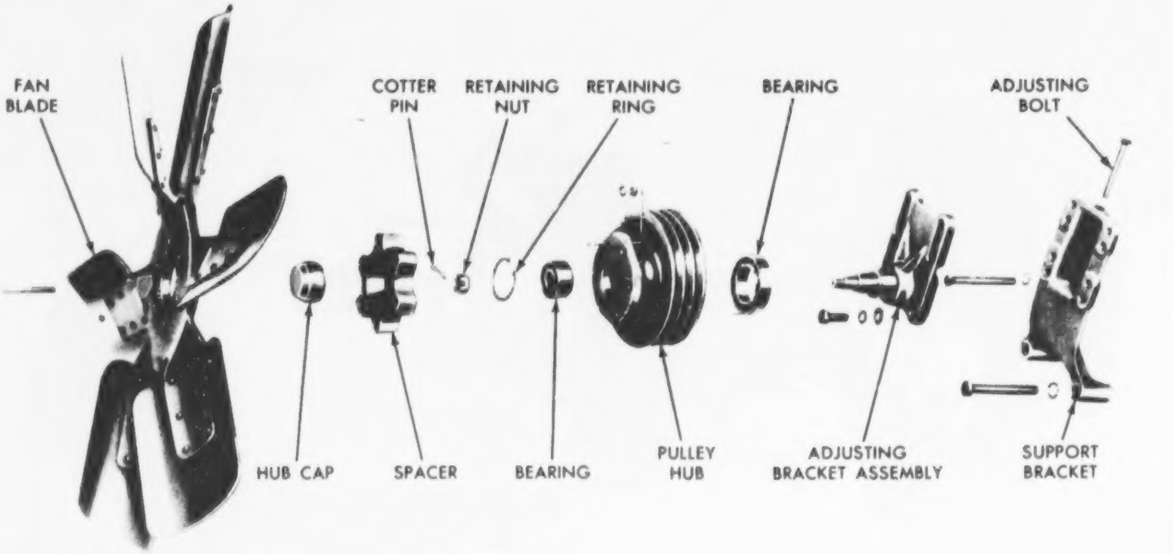
TWIN PLATE OIL COOLER

P 608B


GASKETS
BY-PASS VALVE
SPRING
PLUG
OIL COOLER HOUSING
GASKET
SPACER
GASKET
OIL COOLER CORE
GASKET
DRAIN COCK
OIL COOLER ADAPTOR

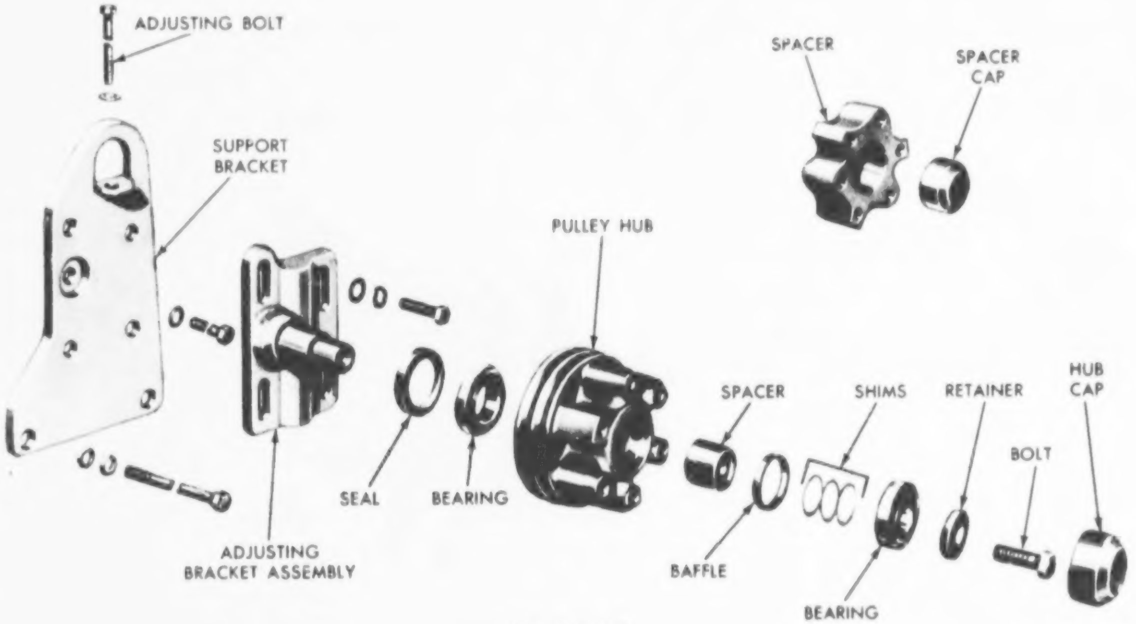
OIL COOLER

P 608


FAN BLADE
COTTER PIN
RETAINING NUT
RETAINING RING
BEARING
ADJUSTING BOLT
HUB CAP
SPACER
BEARING
PULLEY HUB
ADJUSTING BRACKET ASSEMBLY
SUPPORT BRACKET

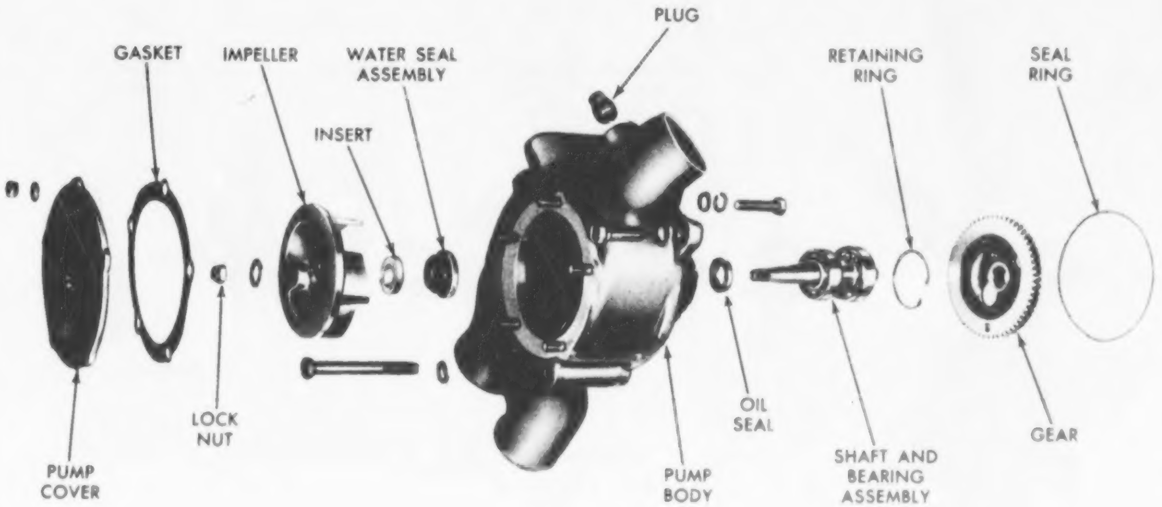
FAN ASSEMBLY

P 610A


ADJUSTING BOLT
SPACER
SPACER CAP
SUPPORT BRACKET
PULLEY HUB
SPACER
SHIMS
RETAINER
HUB CAP
BOLT
SEAL
BEARING
ADJUSTING BRACKET ASSEMBLY
BAFFLE
BEARING

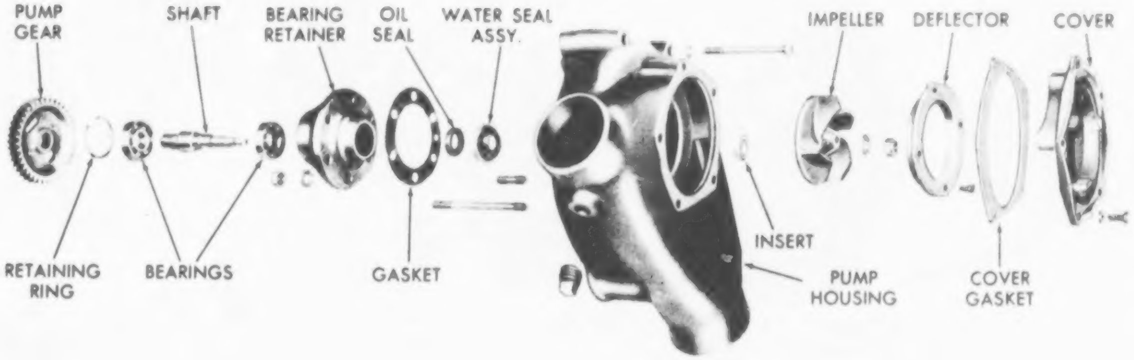
FAN MOUNT

P 610


PLUG
GASKET
IMPELLER
WATER SEAL ASSEMBLY
INSERT
RETAINING RING
SEAL RING
LOCK NUT
PUMP COVER
PUMP BODY
OIL SEAL
SHAFT AND BEARING ASSEMBLY
GEAR

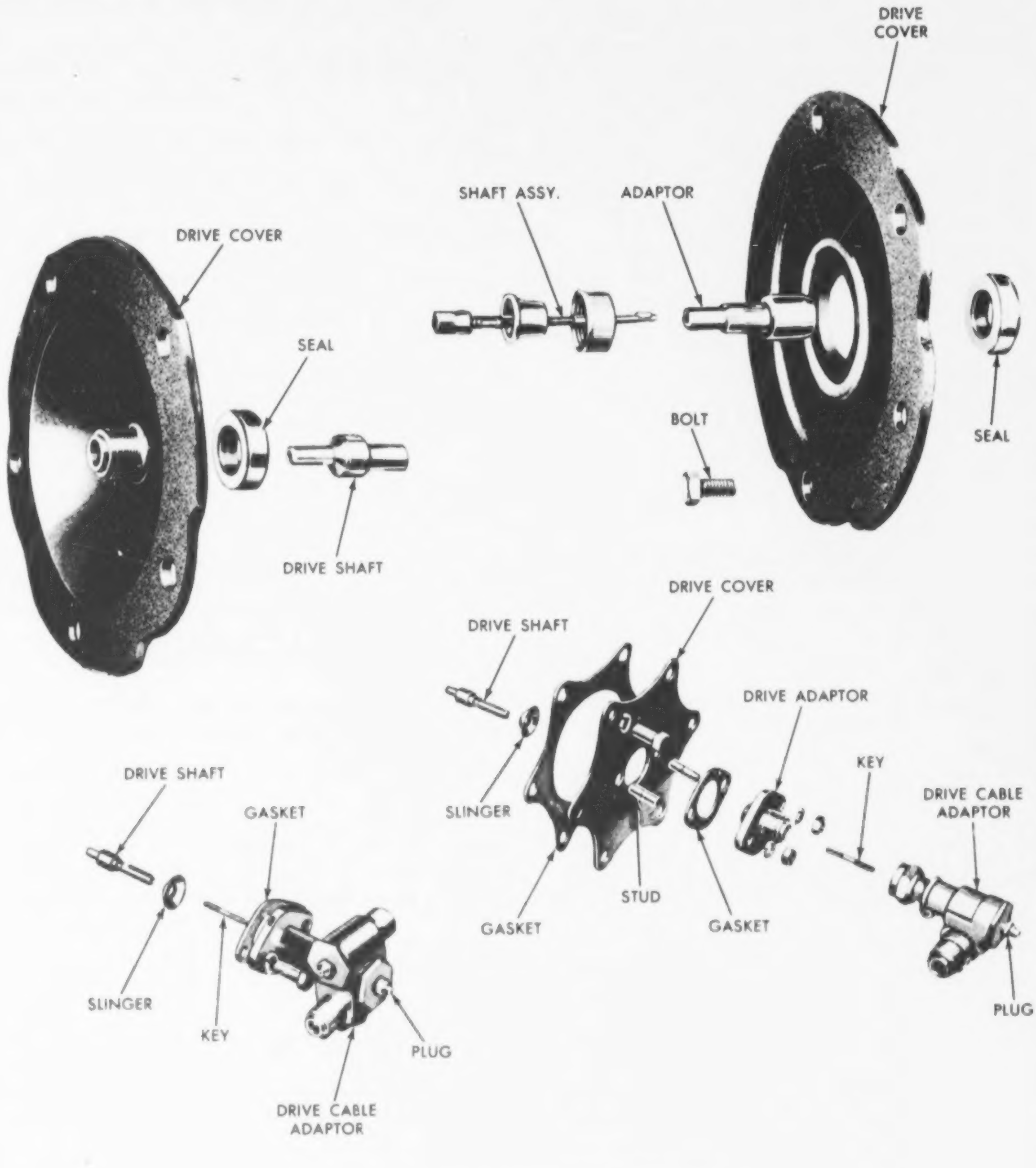
WATER PUMP (6, 8, 12V)

P 612A


PUMP GEAR
SHAFT
BEARING RETAINER
OIL SEAL
WATER SEAL ASSY.
IMPELLER
DEFLECTOR
COVER
RETAINING RING
BEARINGS
GASKET
INSERT
PUMP HOUSING
COVER GASKET

WATER PUMP (16V)

P 612


DRIVE COVER
SHAFT ASSY.
ADAPTOR
DRIVE COVER
SEAL
BOLT
SEAL
DRIVE SHAFT
DRIVE COVER
DRIVE SHAFT
DRIVE ADAPTOR
KEY
DRIVE SHAFT
GASKET
SLINGER
DRIVE CABLE ADAPTOR
STUD
GASKET
GASKET
PLUG
SLINGER
KEY
PLUG
DRIVE CABLE ADAPTOR

TACHOMETER DRIVE COVERS AND ADAPTORS

P 611

OWNER ASSISTANCE

The satisfaction and goodwill of the owners of Detroit Diesel engines are of primary concern to the Detroit Diesel Allison Division, its distributors and their dealers.

As an owner of a Detroit Diesel engine, you have a complete network of over 2300 Detroit Diesel Allison Distributors and Dealers in the U.S. and Canada, plus many outlets worldwide that are prepared and anxious to meet your parts and service needs:

Expert service by trained personnel.

Emergency service 24 hours a day.

Complete parts support, including reliabilt components.

Sales teams to help determine your power requirements.

Product information and literature.

We recognize, however, that despite the best intentions of everyone concerned, misunderstandings may occur. Normally, any such situation that arises in connection with the sale, operation or service of your engine will be handled by the distributor or dealer in your area (check the Yellow Pages for the Detroit Diesel Allison Service Outlet nearest you).

To further assure your complete satisfaction, we have developed the following three-step procedure to be followed in the event you have a problem that has not been handled satisfactorily.

Step One - **Discuss your problem with a member of management from the distributorship or dealership.** Frequently, complaints are the result of a breakdown in communication and can quickly be resolved by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. If your problem originates with a dealer, explain the matter to a management member of the distributorship with whom the dealer has his service agreement.

Step Two - When it appears that your problem cannot readily be resolved at the distributor level without additional assistance, **contact the Detroit Diesel Allison Regional Office nearest you listed below:**

Eastern Region
Suite 202
10 Parsonage Road
Edison, New Jersey 08817
Phone: (201) 246-5074
Regional Manager: S. F. Zappia
Service Manager: D. P. Friedrich

Great Lakes Region
Garrison Place
19855 Outer Drive
Dearborn, Michigan 48124
Phone: (313) 565-0411
Regional Manager: A. W. Christy
Service Manager: R. Schwaller

Southwestern Region
Suite 130
2655 Villa Creek Drive
Dallas, Texas 75234
Phone: (214) 241-7721
Regional Manager: F. A. Skells
Service Manager: W. C. Kaphengst

Southeastern Region
5730 Glenridge Drive, N.E.
Atlanta, Georgia 30328
Phone: (404) 252-3310
Regional Manager: L. R. Kirby
Service Manager: B. D. Robison, Jr.

Midwestern Region
Suite 618
2021 Spring Road
Oak Brook, Illinois 60521
Phone: (312) 654-6619
Regional Manager: C. O. Zimmerman
Service Manager: T. F. Chope

Northwestern Region
Suite 250
20380 Town Center Lane
Cupertino, California 95014
Phone: (408) 255-7700
Regional Manager: W. C. Edwards
Service Manager: J. P. Miles

Western Region
Suite 823
Crocker Bank Building
15760 Ventura Blvd.
Encino, California 91436
Phone: (213) 981-7300
Regional Manager: G. J. Dunneback
Service Manager: W. K. Clark, Jr.

Prior to this call, have the following information available:

- Name and location of distributor or dealer.
- Type and make of equipment.
- Engine model and serial number.
- Engine delivery date and accumulated miles or hours of operation.
- Nature of problem.
- Chronological summary of unit's history.

Step Three - If you are still not satisfied, **present the entire matter in writing or by phone to the Home Office:**

Diesel Operations - J. E. Fisher, Manager Customer Services, Detroit Diesel Allison, 13400 W. Outer Drive, Detroit, Michigan 48228, Phone (313) 592-5608.

Canada Operations - E. A. Kobe, Manager of Product Service, Diesel Division, General Motors of Canada, Ltd., P.O. Box 5990, 847 Highbury Avenue, London, Ontario N6A 4L6, Phone (519) 455-7110.

If at this point your problem is still not resolved to your satisfaction, call or write J. P. Lewis, Manager, Diesel Engine Service, Diesel Operations (313) 592-7279; D.F. Downham, Sales Manager, Diesel Operations (313) 592-7276.

When contacting the Regional or Home Office, please keep in mind that ultimately your problem will likely be resolved at the distributorship or dealership utilizing their facilities, equipment and personnel. Therefore, it is suggested that you follow the above steps in sequence when experiencing a problem.

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Volume 3
Engine Parts List

Detroit Diesel Engines

V-71 MODELS

FEBRUARY 1977

750 CFM Rotary Screw Air Compressor

Stock Number 4310-01-053-3891
Contract DSA700-77-C-8407

GROUP NAME	GROUP NO.	TYPE
Cylinder Block	1.1000	167
Air Box Drains	1.1000A	103
Cylinder Head	1.2000	100
Engine Lifter Bracket	1.2000A	32
Crankshaft	1.3000	54
Crankshaft Pulley	1.3000C	139
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GENERAL INFORMATION

GENERAL INFORMATION

All engine components in this catalog are divided into twelve major groups of functionally related parts. A listing of the groups and their sub-groups appears under "Group Nomenclature" on page 4 of this section.

Within each sub-group different designs of similar equipment are shown, each being designated by a type number. The type number in one sub-group has no relationship to the same type number in another sub-group.

Each Engine Model is provided with a Model Index, which shows the Standard and Standard Option type numbers currently available on the model. All optional material type numbers are listed on the engine Option Plate, as shown in the illustration below.

The names and type numbers of optional equipment built into the unit at the factory are listed on this plate, along with the unit model, serial number and customer specification number (if any). Material not listed on the Option Plate is standard equipment and the type number is obtained from the model index. (Copies of the information, on the Option Plate Work Sheet, are furnished to distributors for their files.)

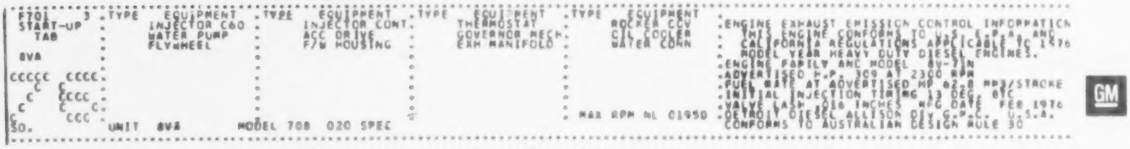
To locate a part, first, establish the group where the part is used (see the Alphabetical Index or Group Nomenclature page) then, determine the type number for the group from either the Option Plate or the Model Index. With this information, turn to the proper group and locate the type number at the top of the page. All parts applicable to the type are indicated by the quantity indicated in the column. An AR in this column indicates an "as required" quantity.

EXAMPLE

For purposes of illustration, a model 7063-7200 unit will be used. The following examples cover the steps to be followed:

1. To determine the part number of the crankshaft, refer to the Option Plate and note there is no reference to it, indicating it is standard equipment. Next turn to the Model Index and establish that the crankshaft is type 23 in group 1.3000. Turn to group 1.3000 and locate type 23 at the top of the page. All items with a quantity in this column apply to this unit. In sub-group 1.3001 crankshaft assy., the quantity in type 23 column shows the crankshaft to be part number 5146733.

2. To determine the proper crankshaft pulley for this unit again refer to the Option Plate and note that Crankshaft Pulley type number is 113, consult the group nomenclature page to establish that crankshaft pulley is group 1.3000C. Now turn to group 1.3000C and find type 113 at the top of the page. The quantity shown in type 113 at sub-group 1.3280 shows the crankshaft pulley to be part number 5122237.



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F701      3 .TYPE   EQUIPMENT  .TYPE    EQUIPMENT  .TYPE    EQUIPMENT  .TYPE    EQUIPMENT  .
START-UP    .       INJECTOR C60.       INJECTOR CONT.      THERMOSTAT  .       ROCKER COV  .ENGINE EXHAUST EMISSION CONTROL INFORMATION
  TAB       .       WATER PUMP  .       ACC DRIVE   .       GOVERNOR MECH.      OIL COOLER  .  THIS ENGINE CONFORMS TO U.S. E.P.A. AND
            .       FLYWHEEL    .       F/W HOUSING .       EXH MANIFOLD.       WATER CONN  .  CALIFORNIA REGULATIONS APPLICABLE TO 1976
 8VA        .                   .                   .                   .                   .  MODEL YEAR HEAVY DUTY DIESEL ENGINES.
            .                   .                   .                   .                   .ENGINE FAMILY AND MODEL  8V-71N
CCCCC  CCCC.                    .                   .                   .                   .ADVERTISED H.P. 309 AT 2300 RPM
  C   C     .                   .                   .                   .                   .FUEL RATE AT ADVERTISED HP 62.8 MM3/STROKE
 C    CCCC  .                   .                   .                   .                   .INITIAL INJECTION TIMING 13 DEG. BTC
C     C   C.                    .                   .                   .                   .VALVE LASH .016 INCHES  MFG DATE  FEB 1976
C      CCC  .                   .                   .                   . MAX RPM NL 01950  .DETROIT DIESEL ALLISON DIV G.M.C.  U.S.A.
SO.         . UNIT  8VA     MODEL 708  020 SPEC                                              CONFORMS TO AUSTRALIAN DESIGN RULE 30
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14486

ASSEMBLY BREAKDOWN

The Assembly Breakdown section is designed to eliminate repeating components of assemblies and sub-assemblies. When the Assembly Breakdown is used it is always found at the end of the group it pertains to. The pages are numbered with an alphabetical prefix. Assemblies which make use of the Assembly Breakdown will have a note to that effect under the sub-group heading. The note will refer to the page on which the assembly is shown. The part number will appear in the first group of the Assembly Breakdown showing the quantity used in one of the alphabetically designated columns. All other items appearing in that column are components of the assembly.

ALPHABETICAL INDEX

The Alphabetical Index on page 5 is particularly helpful when only a part name is known and the group can not readily be determined. Parts are listed alphabetically by noun name, followed by a description of the application of the part and the final group location. Component parts of assemblies are not listed since they will appear in the body of the book immediately following the assembly to which they belong.

PARTS RELEASE

A Parts Release on Microfiche, is issued periodically to keep this catalog up-to-date. It consists of revised Fiche for insertion in the set. All new Fiche carry a date of issue. These should be inserted into the deck immediately upon receipt. Old Fiche may then be destroyed.

A checklist is included with each Microfiche update. This checklist will indicate, by date, those Fiche revised and reissued.

MISCELLANEOUS

At the beginning of each of the sections of this catalog there are several pages of illustrations. In each section of the parts list figure numbers refer to illustrations within that section only unless otherwise noted. In the majority of cases illustrations are typical, that is, they may represent more than one part number. For example, in the case of the flywheel housing, figure 3B of section 1.0000, a single housing is shown to represent all housings. Key numbers on illustrations are final group numbers.

In many instances a part has more than one application. Wherever a part appears in its second or third application the basic group is shown in parenthesis following the description.

Unless otherwise specified, standard bolts in the parts list are hexagon head. Other standard parts are described in detail.

The information and illustrations in this publication are based on the inoformation in effect at the time of approval for printing. The right is reserved to make changes at any time without notice.

YOUR PARTS ORDER WILL BE HANDLED MORE EFFICIENTLY IF YOU—

1. Provide the following information for material ordered:
   - A. Group in parts book in which it is specified.
   - B. Quantity desired.
   - C. Part Number.
   - D. Complete Nomenclature.
   - E. The Type number for the model concerned.
   - F. Complete unit model identification and serial number.
   - G. "TYPE" rather than "WRITE" the above information.
2. Furnish complete shipping instruction. This is particularly important in case the order is not to be handled in the regular manner. Indicate whether shipment should be made via parcel post, express, air freight, etc.
3. Confirm all telegraph and telephone orders immediately, clearly marking any such orders "CONFIRMING" to avoid duplication of shipment of such orders.

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover

2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls

3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler

4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System

5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter

6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections

7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid

8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines

9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission—Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car

10.0000	SHEET METAL
10.1000A	Engine Hood

11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base

12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits

A

ACCUMULATOR, AIR HEATER . . . . 7.8415 A
ACCUMULATOR, HYDRAULIC STARTER. . . . .12.6570 D
ADAPTOR ASSY., FUEL PUMP DRIVE. 2.2260
ADAPTOR ASSY., OIL COOLER . . . . 4.4110 A
ADAPTOR ASSY., OVERSPEED VALVE DRIVE CABLE . . . . 7.4587 C
ADAPTOR KIT, TACHOMETER DRIVE . . . . . 7.4418 B
ADAPTOR, ACCESSORY DRIVE. . . . . 1.7622 B
ADAPTOR, AIR CLEANER MOUNTING . . . . . 3.1085 A
ADAPTOR, AIR COMPRESSOR . . . . .12.4020 A
ADAPTOR, AIR DUCT . . . . 5.4620 B
ADAPTOR, AIR INLET HOUSING. . . . . . . 3.3004 A
ADAPTOR, AIR SILENCER . . . . 3.2015 A
ADAPTOR, ASSY., OIL COOLER. . . . . . . 4.4110 A
ADAPTOR, CYLINDER HEAD GOVERNOR CONTROL LINK. . . . . 2.8945 A
ADAPTOR, DIPSTICK . . . . 4.6030 A
ADAPTOR, EXHAUST OUTLET . . . . 6.2120 A
ADAPTOR, EXHAUST PIPE . . . . 6.1190 A
ADAPTOR, FLYWHEEL HOUSING . . . . 1.5130 B
ADAPTOR, GOVERNOR DRIVE TACHOMETER DRIVE . . . . 2.8930 A
ADAPTOR, HYDRAULIC MARINE GEAR OIL PUMP. . . . . 9.1477 A
ADAPTOR, HYDRAULIC MARINE GEAR OIL PUMP. . . . . 9.1477 A
ADAPTOR, HYDRAULIC PUMP . . . . .12.5020 A
ADAPTOR, HYDRAULIC PUMP DRIVE SHAFT BEARING . . . . .12.5037 A
ADAPTOR, MARINE GEAR OIL PUMP . . . . . 9.1477 A
ADAPTOR, OIL FILLER . . . . 4.5005 A
ADAPTOR, OIL FILTER . . . . 4.2290 A
ADAPTOR, OIL FILTER . . . . 8.1977 A
ADAPTOR, OIL FILTER . . . . 8.3873 B
ADAPTOR, OIL FILTER . . . . 9.1782 A
ADAPTOR, OIL FILTER COVER . . . . 4.2291 A
ADAPTOR, OIL FILTER TUBE (TO OIL COOLER ADAPTOR) . . . . 4.3025 A
ADAPTOR, OVERSPEED TRIP GOVERNOR. . . . 7.4635 C
ADAPTOR, POWER TAKE-OFF TO CLUTCH . . . 8.1905 A
ADAPTOR, STARTER DRIVE. . . . . .12.6065 A
ADAPTOR, TACHOMETER DRIVE . . . . 7.4420 B
ADAPTOR, TACHOMETER DRIVE . . . . 7.4457 B
ADAPTOR, TACHOMETER DRIVE CABLE . . . . 7.4420 B
ADAPTOR, TACHOMETER DRIVE COVER . . . . 7.4457 B
ADAPTOR, TACHOMETER MOUNTING. . . . . . 7.4061 A
ADAPTOR, THROTTLE CONTROL KNOB. . . . . 2.9132 A
ADAPTOR, TURBOCHARGER EXHAUST OUTLET. . . . . 3.5324 A
ADAPTOR, TURBOCHARGER EXHAUST OUTLET. . 3.5324 A
ADAPTOR, WATER TEMPERATURE GAGE . . . . 7.4084 A
ADAPTOR, WATER TEMPERATURE SWITCH . . . 7.4509 C
AIR CLEANER ASSEMBLY. . . . . 3.1001 A
AIR CLEANER ASSY. . . . . 3.1001 A
AIR STARTER ASSY. . . . . .12.6080 B
AIR STRAINER AND LUBRICATOR ASSY., AIR STARTER . . . . .12.6120 B
AMMETER, BATTERY CHARGING . . . . 7.4015 A
ARM ASSY., EXHAUST VALVE ROCKER 1.8060
ARM ASSY., INJECTOR ROCKER. 1.8080
ASPIRATOR, EXHAUST. . . . . 3.1003 A
ATTACHING PARTS, CYLINDER BLOCK FRONT TO REAR 16V.. . . . . 1.1003

B

BAFFLE, BREATHER. . . . . 4.8025 A
BAFFLE, GENERATOR FAN . . . . 7.1470 A
BAFFLE, OIL COOLER HOUSING. . . . . . . 4.4085 A
BAFFLE, OIL PAN . . . . 4.7045 A
BAFFLE, RADIATOR TANK (UPPER) . . . . . 5.3265 A
BAFFLE, REDUCTION GEAR OIL. . . . . . . 9.1380 A
BALL HEAD ASSY., GOVERNOR . . . . 2.8560 A
BALLHEAD, OVERSPEED TRIP GOVERNOR (HYDRAULIC) . . . . 7.4617 C
BASE, AUTOMATIC STARTING CONTACT SPRING. . . . . 7.2255 B
BASE, ENGINE MOUNTING . . . . .11.1001 A
BASE, GOVERNOR. . . . . 2.8650 A
BASE, GOVERNOR. . . . . 8.3380 A
BASE, TURBOCHARGER RATIO CONTROLLER . . 3.5710 A
BATTERY ASSY. . . . . 7.2001 A
BEARING . . . . 8.1940 A
BEARING, ACCESSORY DRIVE. . . . . 1.7655 B
BEARING, AIR COMPRESSOR DRIVE SHAFT . . . . .12.4048 A
BEARING, AIR COMPRESSOR DRIVE SHAFT . .12.4048 A
BEARING, AIR COMPRESSOR DRIVE SHAFT SHAFT . . . . .12.4048 A
BEARING, BILGE PUMP SHAFT . . . . . . .12.2100 A
BEARING, BLOWER DRIVE GEAR HUB SUPPORT 3.4355
BEARING, BLOWER ROTOR FRONT 3.4040
BEARING, BLOWER ROTOR REAR. 3.4060
BEARING, CAMSHAFT END 1.7010
BEARING, CAMSHAFT INTERMEDIATE. 1.7040
BEARING, CLUTCH DRIVE SHAFT . . . . . . 8.1680 A
BEARING, CLUTCH PILOT . . . . 1.4040 A
BEARING, CLUTCH PILOT . . . . 8.1450 A
BEARING, CLUTCH RELEASE . . . . 8.1250 A
BEARING, CRANKSHAFT FRONT TRUNNION. . .11.1085 A
BEARING, FAN SHAFT. . . . . 5.4110 A
BEARING, FAN SHAFT (FOR CUSTOMER FURNISHED HUB). . . . . 5.4110 A
BEARING, FLYWHEEL PILOT . . . . 9.1210 A
BEARING, FRESH WATER PUMP 5.1070
BEARING, GEAR BOX DRIVE GEAR. . . . . . 9.3030 A
BEARING, GEAR BOX OUTPUT SHAFT FRONT. . 9.3070 A
BEARING, GEAR BOX OUTPUT SHAFT-REAR . . 9.3100 A
BEARING, GENERATOR DRIVE. . . . . 7.1535 A
BEARING, GOV. DRIVE THRUST. . . . . . . 2.8830 A
BEARING, GOV. DRIVEN SHAFT. . . . . . . 2.8810 A
BEARING, GOVERNOR DRIVE . . . . 7.1535 A
BEARING, GOVERNOR DRIVE THRUST. . . . . 2.8830 A
BEARING, GOVERNOR DRIVEN SHAFT. . . . . 2.8810 A
BEARING, GOVERNOR OPERATING BELL CRANK . . . . 2.8967 A
BEARING, GOVERNOR OPERATING SHAFT . . . 8.3410 A
BEARING, GOVERNOR OPERATING SHAFT (LOWER) . . . . 2.7270 A
BEARING, GOVERNOR OPERATING SHAFT (UPPER) . . . . 2.7260 A
BEARING, GOVERNOR OPERATING SHAFT (UPPER) . . . . 2.7260 A

PART NAME GROUP NO.

BEARING, GOVERNOR PILOT VALVE PLUNGER THRUST. . . 2.8610 A
BEARING, GOVERNOR RISER THRUST. . . 8.3425 A
BEARING, GOVERNOR ROCKER SHAFT. . . 8.3440 A
BEARING, GOVERNOR THROTTLE SHAFT. . . 2.7100 A
BEARING, GOVERNOR VARIABLE SPEED SPRING LEVER. . . 2.7732 A
BEARING, GOVERNOR VARIABLE SPEED SPRING LEVER SHAFT. . . 2.7712 A
BEARING, GOVERNOR WEIGHT. . . 2.7440 A
BEARING, GOVERNOR WEIGHT RISER THRUST. . . 2.7460 A
BEARING, GOVERNOR WEIGHT RISER THRUST . . . 2.7460 A
BEARING, GOVERNOR WEIGHT SHAFT END. . . 2.7470 A
BEARING, HYDRAULIC PUMP DRIVE SHAFT . . .12.5033 A
BEARING, HYDRAULIC STARTER END. . . .12.6540 D
BEARING, HYDRAULIC STARTER ENGINE PUMP. . . .12.6602 D
BEARING, HYDRAULIC STARTER ENGINE PUMP PISTON . . .12.6610 D
BEARING, IDLER GEAR . . . 1.7225
BEARING, OVERSPEED TRIP GOVERNOR OPERATING . . . 7.4647 C
BEARING, OVERSPEED TRIP GOVERNOR OPERATING SHAFT . . . 7.4647 C
BEARING, PILLOW BLOCK . . . 8.1740 A
BEARING, PISTON PIN . . . 1.6142
BEARING, PLANETARY GEAR PINION. . . 9.1083 A
BEARING, RAW WATER PUMP . . . 5.6130 A
BEARING, REDUCTION GEAR DRIVE SHAFT PILOT . . . 9.1345 A
BEARING, REDUCTION GEAR DRIVE SHAFT THRUST. . . 9.1350 A
BEARING, REDUCTION GEAR PINION. . . 9.1320 A
BEARING, REDUCTION GEAR SHAFT . . . 8.1945 A
BEARING, REDUCTION GEAR SHAFT PILOT . . . 8.1940 A
BEARING, ROTOR ASSY. SHAFT. . . 3.5027 A
BEARING, ROTOR ASSY., SHAFT . . . 3.5027 A
BEARING, STARTER DRIVE. . . .12.6060 A
BEARING, SUN GEAR . . . 9.1073 A
BEARING, THERMO FAN . . . 5.4365 A
BEARING, THROTTLE CONTROL BELL CRANK SUPPORT . . . 2.9705 A
BELL CRANK ASSY., GOVERNOR OPERATING . . . 2.8965 A
BELL CRANK ASSY., GOVERNOR OPERATING. . 2.8965 A
BELL CRANK ASSY., GOVERNOR OPERATING OPERATING . . . 2.8965 A
BELL CRANK, THROTTLE CONTROL. . . 2.9710 A
BELL, ALARM SYSTEM. . . 7.4513 C
BELT, AIR COMPRESSOR DRIVE. . . .12.4045 A
BELT, CRANKSHAFT PULLEY DRIVE . . . 1.3320 D
BELT, GENERATOR DRIVE . . . 7.1575 A
BELT, HYDRAULIC PUMP DRIVE. . . .12.5009 A
BLADE ASSY., FAN. . . 5.4010 A
BLADE, FAN. . . 5.4010 A
BLOCK ASSY., CYLINDER . . . 1.1001
BLOCK KIT, CONVERSION . . . 1.1004
BLOCK TERMINAL. . . 7.4547 C
BLOCK, CONTROL TERMINAL . . . 7.2340 B
BLOCK, CYLINDER . . . 1.1001
BLOCK, FUEL SYSTEM JUNCTION . . . 2.5250 A
BLOCK, GOV. MOTOR TERMINAL. . . 2.8189
BLOCK, GOV. MOTOR TERMINAL. . . 2.8189 A
BLOCK, INSTRUMENT PANEL FUSE. . . 7.4135 A
BLOCK, OIL COOLER OIL JUNCTION. . . 4.4328 A
BLOWER ASSY.. . . . 3.4001
BLOWER KIT, REPAIR. . . 3.4005
BODY ASSY., INJECTOR. . . 2.1020 A
BODY, AIR HEATER. . . 7.8030 A
BODY, BILGE PUMP. . . .12.2010 A
BODY, BREATHER. . . 4.8050 A
BODY, EXHAUST RESTRICTOR AIR CYLINDER. . . 6.2200 A
BODY, FRESH WATER PUMP. . . 5.1030
BODY, FUEL PUMP . . . 2.2010
BODY, GOVERNOR. . . 8.3370 A
BODY, HYDRAULIC PUMP. . . 5.1465 A
BODY, HYDRAULIC STARTER CONTROL VALVE . . .12.6517 D
BODY, HYDRAULIC STARTER ENGINE PUMP. . . .12.6595 D
BODY, HYDRAULIC STARTER HAND PUMP . . .12.6633 D
BODY, MASTER CYLINDER . . .12.6810 E
BODY, OIL PRESSURE REGULATOR. . . 4.1680 C
BODY, OIL PUMP. . . 4.1040 A
BODY, RAW WATER PUMP. . . 5.6030 A
BODY, WATER FILTER. . . 5.7013 A
BOLT, AIR CLEANER . . . 3.1070 A
BOLT, CRANKSHAFT MAIN BEARING CAP . . . 1.3140
BOLT, FORWARD CLUTCH EMERGENCY ENGAGEMENT. . . 9.1220 A
BOLT, FORWARD CLUTCH EMERGENCY RELEASE . . . 9.1220 A
BOLT, ROCKER COVER. . . 1.8460 A
BOOT, HYDRAULIC STARTER HAND PUMP CAM . . .12.6645 D
BOOT, INJECTOR CONTROL TUBE LINK. . . 2.8950 A
BRACE, ENGINE FRONT COVER . . . 1.2067
BRACE, ENGINE FRONT COVER FAN . . . 5.4390 A
BRACKET ASSY., ANTI-STALL LEVER . . . 2.8552 A
BRACKET, AIR CLEANER MOUNTING . . . 3.1230 A
BRACKET, AIR COMP. MTG. . . .12.4010 A
BRACKET, AIR COMPRESSOR MOUNTING. . . .12.4010 A
BRACKET, AIR CYLINDER MOUNTING. . . 6.2212 A
BRACKET, AIR HEATER COIL. . . 7.8050 A
BRACKET, AIR HEATER MOUNTING. . . 7.8002 A
BRACKET, AIR HEATER PUMP AND VALVE. . . 7.8203 A
BRACKET, AIR SHUT-OFF SOLENOID. . . 7.4530 C
BRACKET, AIR SHUT-OFF SOLENOID LIMIT SWITCH. . . 7.4535 C
BRACKET, AIR SHUT-OFF SOLENOID LIMIT SWITCH. . . 7.4535 C
BRACKET, AIR SHUTOFF SOLENOID . . . 7.4530 C
BRACKET, AIR SHUTOFF SOLENOID LIMIT SWITCH. . . 7.4535 C
BRACKET, AIR STARTER. . . .12.6170 B
BRACKET, ALARM SHUT-OFF SWITCH. . . 7.4600 C
BRACKET, ALARM SHUTOFF SWITCH . . . 7.4600 C
BRACKET, AUTOMATIC STARTING GEAR AND CAM . . . 7.2260 B
BRACKET, AUTOMATIC STARTING LIMIT SWITCH. . . 7.2263 B
BRACKET, AUTOMATIC STARTING SOLENOID. . 7.2245 B
BRACKET, BREATHER EXT. PIPE . . . 4.8183 A

PART NAME . . . . GROUP NO.

BRACKET, BREATHER EXTENSION PIPE. . . . . 4.8183 A
BRACKET, BREATHER TUBE CLIP . . . . 4.8042 A
BRACKET, CONVERTER OIL FILTER MOUNTING. . . . . 8.3880 B
BRACKET, CYLINDER THROTTLE DELAY ROCKER SHAFT. 2.9030
BRACKET, DRAIN TANK MOUNTING. . . . . . . 1.1240 A
BRACKET, ENGINE LIFTER FRONT. . . . . . . 1.2070 A
BRACKET, ENGINE LIFTER REAR . . . . 1.2080 A
BRACKET, EXHAUST MUFFLER MOUNTING STRAP . . . . 6.2035 A
BRACKET, FAN SHAFT. . . . . 5.4090 A
BRACKET, FUEL FILTER MOUNTING . . . . . . 2.3530 A
BRACKET, FUEL FILTER MTG. . . . . 2.3530 A
BRACKET, FUEL PUMP. 2.2015
BRACKET, FUEL STRAINER MOUNTING 2.3260
BRACKET, FUEL STRAINER MOUNTING . . . . . 2.3260 A
BRACKET, FUEL STRAINER MTG. . . . . 2.3260 A
BRACKET, FUEL SUPPLY TO STRAINER TUBE CLIP . . . . 2.5030 A
BRACKET, FUEL SYSTEM JUNCTION BLOCK . . . 2.5252 A
BRACKET, GENERATOR ADJUSTING. . . . . . . 7.1582 A
BRACKET, GENERATOR ADJUSTING STRAP. . . . 7.1582 A
BRACKET, GENERATOR ADJUSTING STRAP SUPPORT . . . . 7.1583 A
BRACKET, GENERATOR DRIVE AND PULLEY GUARD . . . . 7.1587 A
BRACKET, GENERATOR DRIVE BELT & PULLEY GUARD. . . . . 7.1587 A
BRACKET, GENERATOR DRIVE BELT AND PULLEY GUARD. . . . . 7.1587 A
BRACKET, GENERATOR MOUNTING . . . . 7.1595 A
BRACKET, GENERATOR MTG. . . . . 7.1595 A
BRACKET, GENERATOR VOLTAGE REGULATOR MOUNTING. . . . . 7.1606 A
BRACKET, GENERATOR VOLTAGE REGULATOR MOUNTING . . . . 7.1606 A
BRACKET, GENERATOR VOLTAGE REGULATOR MOUNTING. . . . . 7.1606 A
BRACKET, GOV. OIL RESERVOIR . . . . 2.8907 A
BRACKET, GOVERNOR CONTROL RETRACTING SPRING . . . . 2.9406 A
BRACKET, GOVERNOR CONTROL RETRACTING SPRING. . . . . 2.9406 A
BRACKET, GOVERNOR CONTROL SHAFT REAR. . . . . 2.9220 A
BRACKET, GOVERNOR CONTROL SHAFT REAR. . 2.9220 A
BRACKET, GOVERNOR LEVER RETRACTING SPRING. . . . . 2.7220 A
BRACKET, GOVERNOR OIL RESERVOIR . . . . . 2.8907 A
BRACKET, GOVERNOR OPERATING SOLENOID VALVE. . . . . 2.8917 A
BRACKET, GOVERNOR OPERATING SOLENOID VALVE . . . . 2.8917 A
BRACKET, GOVERNOR SPEED ADJUSTING SHAFT . . . . 8.3455 A
BRACKET, GOVERNOR SPEED ADJUSTING LEVER . . . . 2.8440 A
BRACKET, HEAT EXCHANGER MOUNTING. . . . . 5.5070 A
BRACKET, HEAT EXCHANGER MTG.. . . . . . . 5.5070 A
BRACKET, HYDRAULIC PUMP SUPPORT . . . . .12.5023 A
BRACKET, HYDRAULIC STARTER ENGINE PUMP. . . . . .12.6670 D
BRACKET, HYDRAULIC STARTER FILTER MOUNTING. . . . . .12.6803 F
BRACKET, HYDRAULIC STARTER HAND PUMP. . . . . .12.6684 D
BRACKET, HYDRAULIC STARTER HAND PUMP. .12.6684 D
BRACKET, INJECTOR CONTROL TUBE. 2.9003
BRACKET, INTERCOOLER MOUNTING . . . . . . 3.5426 A
BRACKET, OIL COOLER COVER . . . . 4.4062 A
BRACKET, OIL COOLER HOUSING SUPPORT . . . 4.4100 A
BRACKET, OIL FILLER TUBE CLAMP. . . . . . 4.5064 A
BRACKET, OIL FILTER LINE CLIP . . . . . . 4.3050 A
BRACKET, OIL FILTER MOUNTING. . . . . . . 2.8955 A
BRACKET, OIL FILTER MOUNTING. . . . . . . 4.2440 A
BRACKET, OIL FILTER MOUNTING. . . . . . . 4.4367 A
BRACKET, OIL FILTER MOUNTING. . . . . . . 8.1588 A
BRACKET, OIL FILTER MOUNTING. . . . . . . 5.1793 A
BRACKET, OIL PAN DRAIN TUBE . . . . 4.7112 A
BRACKET, OIL PUMP OUTLET PIPE . . . . . . 4.1575 B
BRACKET, OIL PUMP SCREEN SUPPORT. . . . . 4.1540 B
BRACKET, OIL STRAINER MOUNTING. . . . . . 9.1710 A
BRACKET, OVERSPEED TRIP GOVERNOR SWITCH. . . . . 7.4664 C
BRACKET, RADIATOR MOUNTING. . . . . 5.3260 A
BRACKET, ROCKER SHAFT 1.8170
BRACKET, STARTING AID PUMP MOUNTING . .12.6391 C
BRACKET, STARTING MOTOR SUPPORT . . . . . 7.3007 A
BRACKET, STARTING MOTOR SWITCH. . . . . . 7.3257 A
BRACKET, THROTTLE BOOSTER SPRING. . . . . 2.9344 A
BRACKET, THROTTLE CONTROL AIR CYLINDER. . . . . 2.9875 A
BRACKET, THROTTLE CONTROL CROSS SHAFT . . . . 2.9675 A
BRACKET, THROTTLE CONTROL KNOB SHAFT . . . . 2.9150 A
BRACKET, THROTTLE CONTROL KNOB SHAFT. . 2.9150 A
BRACKET, THROTTLE CONTROL LEVER . . . . . 2.9570 A
BRACKET, THROTTLE CONTROL SOLENOID. . . . 2.9357 A
BRACKET, TORQUE CONVERTER OUTPUT SHFT GOVRNOR MOUNTNG. . . . . 8.3083 A
BRACKET, TURBOCHARGER AIR INLET . . . . . 3.5358 A
BRACKET, TURBOCHARGER EXHAUST INLET CONNECTION. . . . . 3.5308 A
BRACKET, TURBOCHARGER MOUNTING. . . . . . 3.5300 A
BRACKET, TURBOCHARGER SUPPORT . . . . . . 3.5002 A
BRACKET, WATER CROSSOVER TUBE . . . . . . 5.3475 B
BRACKET, WATER FILTER MOUNTING. . . . . . 5.7080 A
BRACKET, WATER HEATER . . . . .12.6406 C
BREAKER ASSY., CIRCUIT. . . . . 7.6180 A
BREATHER AND FILLER, GEAR BOX . . . . . . 9.3280 A
BREATHER ASSEMBLY . . . . 4.8045 A
BREATHER ASSY.. . . . . 4.8045 A
BREATHER, REDUCTION GEAR. . . . . 8.1965 A
BRIDGE, EXHAUST VALVE 1.8343
BRUSH, STARTING MOTOR . . . . 7.3120 A
BUSHING, ACCESSORY DRIVE GEAR . . . . . . 1.7632 B
BUSHING, BELT FASTENER. . . . . 1.3325 D
BUSHING, BILGE PUMP SHAFT . . . . .12.2050 A
BUSHING, CAMSHAFT END 1.7015
BUSHING, CONNECTING ROD PISTON PIN. . . . 1.6040
BUSHING, EXHAUST VALVE ROCKER ARM-LARGE 1.8100
BUSHING, GOVERNOR CONTROL SHAFT BRACKET . . . . 2.9230 A

PART NAME GROUP NO.

BUSHING, GOVERNOR SHUTDOWN SHAFT . . . 2.7111 A
BUSHING, GOVERNOR SPEED ADJUSTING SHAFT SLEEVE . . . 2.8364 A
BUSHING, GOVERNOR SPEED ADJUSTING SHAFT SPACER CAP . . . 2.8366 A
BUSHING, GOVERNOR SPEED ADJUSTING TERMINAL SLEEVE . . . 2.8483 A
BUSHING, GOVERNOR SUB-CAP . . . 2.8060 A
BUSHING, HYDRAULIC PUMP BODY . . . 9.1486 A
BUSHING, INJECTOR AND EXHAUST VALVE ROCKER ARM CLEVIS . . . 1.8140
BUSHING, INJECTOR AND EXHAUST VALVE ROCKER ARM-SMALL . . . 1.8120
BUSHING, INJECTOR ROCKER ARM-LARGE . . . 1.8110
BUSHING, OIL PUMP BODY . . . 4.1050 A
BUSHING, OIL PUMP COVER . . . 4.1240 A
BUSHING, OVERSPEED TRIP GOVERNOR HOUSING . . . 7.4615 C
BUSHING, PISTON PIN . . . 1.6145
BUSHING, STARTING MOTOR CABLE INSULATING . . . 11.1035 A
BUSHING, STARTING MOTOR CABLE INSULATING . . . 11.1035 A
BUSHING, THROTTLE CONTROL CROSS SHAFT BRACKET . . . 2.9677 A
BUSHING, THROTTLE CONTROL LEVER . . . 2.9641 A
BUSHING, THROTTLE CONTROL SHAFT BRACKET . . . 2.9160 A
BUSHING, THROTTLE CONTROL SHAFT BRACKET . . . 2.9160 A
BUSHING, THROTTLE KNOB SHAFT . . . 2.9110 A
BUSHING, VERNIER THROTTLE CONTROL WORM . . . 2.9142 A
BUTTON, VERNIER THROTTLE CONTROL LOCK . . . 2.9145 A

C

CABINET ASSY., AUTOMATIC STARTING . . . 7.2201 B
CABINET, POWER GENERATOR CONTROL . . . 7.6001 A
CABLE, AMMETER TO STARTER SWITCH . . . 7.7190 A
CABLE, BATTERY JUMPER . . . 7.2030 A
CABLE, BATTERY NEGATIVE . . . 7.2020 A
CABLE, BATTERY POSITIVE . . . 7.2010 A
CABLE, FLEXIBLE SHAFT . . . 12.8500 B
CABLE, GENERATOR TO CONTROL CABINET . . . 7.7220 A
CABLE, GENERATOR TO STARTER . . . 7.7200 A
CABLE, PITCH CONTROL MAGNETIC SWITCH . . . 7.7130 A
CABLE, STARTING MOTOR SOLENOID SWITCH . . . 7.2450 B
CABLE, STARTING MOTOR SOLENOID SWITCH . . . 7.3245 A
CABLE, TACH. DRIVE FLEXIBLE . . . 7.4408 B
CABLE, TACHOMETER DRIVE FLEXIBLE . . . 7.4408 B
CAGE, INJECTOR CHECK VALVE . . . 2.1205 A
CAGE, INJECTOR VALVE . . . 2.1265 A
CAGE, INJECTOR VALVE SPRING . . . 2.1257 A
CAGE, PLANETARY GEAR . . . 9.1081 A
CAM, AUTOMATIC STARTING . . . 7.2265 B
CAM, BLOWER DRIVE COUPLING . . . 3.4390
CAM, GOVERNOR COVER . . . 2.7175 A
CAM, HYDRAULIC STARTER HAND PUMP . . . 12.6643 D
CAM, OVERSPEED VALVE ADJUSTING . . . 7.4740 C

PART NAME GROUP NO.

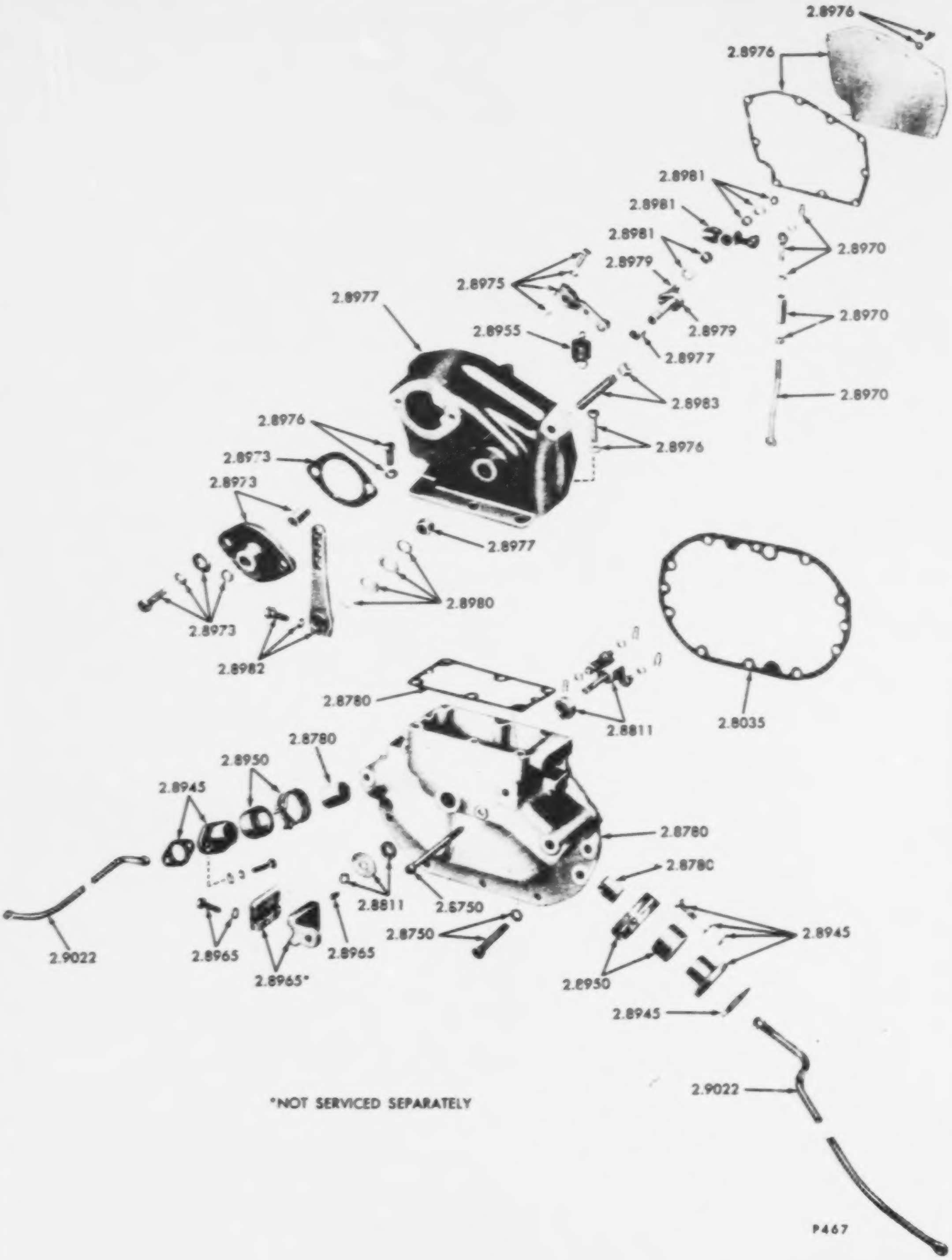
CAP, RAW WATER PUMP BODY OFFSET . . . 5.6035 A
CAMSHAFT . . . 1.7001
CAP & SPACER ASSY., FAN HUB . . . 5.4180 A
CAP AND SPACER ASSY., FAN HUB . . . 5.4180 A
CAP AND SPACER ASSY., FAN HUB (PULLEY CAP ONLY) . . . 5.4180 A
CAP AND SPACER, FAN HUB . . . 5.4180 A
CAP ASSY., OIL PAN DRAIN TUBE . . . 4.7103 A
CAP, AIR HEATER . . . 7.8075 A
CAP, CRANKSHAFT - FRONT . . . 1.3058
CAP, CRANKSHAFT MAIN BEARING . . . 1.3110
CAP, EXHAUST VALVE SPRING . . . 1.8350
CAP, EXPANSION TANK . . . 5.5140 A
CAP, FUEL TANK . . . 2.6030 A
CAP, GEAR BOX BREATHER AND FILLER . . . 9.3300 A
CAP, GOVERNOR LOW SPEED SPRING . . . 2.7580 A
CAP, GOVERNOR SPEED ADJUSTING SHAFT SPACER . . . 2.8365 A
CAP, GOVERNOR WEIGHT HOUSING . . . 2.7510 A
CAP, HYDRAULIC STARTER ACCUMULATOR . . . 12.6573 D
CAP, HYDRAULIC STARTER RESERVOIR . . . 12.6555 D
CAP, INJECTOR FILTER . . . 2.1130 A
CAP, INJECTOR SHIPPING . . . 2.1150 A
CAP, OIL FILLER . . . 4.5010 A
CAP, OIL TANK BREATHER . . . 8.3837 B
CAP, OIL TANK BREATHER . . . 11.1250 A
CAP, OVERSPEED TRIP GOVERNOR SPRING . . . 7.4653 C
CAP, OVERSPEED TRIP GOVERNOR SWITCH HOUSING . . . 7.4681 C
CAP, RADIATOR FILLER . . . 5.3120 A
CAP, REDUCTION GEAR OIL FILLER . . . 9.1415 A
CARRIER & WEIGHT ASSY., GOVERNOR . . . 2.7330 A
CARRIER AND WEIGHT ASSY., GOVERNOR . . . 2.7330 A
CARRIER, BLOWER HOUSING END PLATE SEAL RING . . . 3.4158
CARRIER, FLYWHEEL PILOT BEARING . . . 1.4055 A
CARRIER, GOVERNOR WEIGHT . . . 2.7370 A
CARTON, ENGINE PART . . . 12.8050 A
CASING, FLEXIBLE SHAFT . . . 12.8502 B
CHAIN, BLOWER ROTOR GEAR SPROCKET COUPLING . . . 3.4107
CHAIN, OIL FILLER TUBE . . . 4.5030 A
CLAMP AMMETER . . . 7.4020 A
CLAMP, AIR INLET PIPE HOSE . . . 3.1280 A
CLAMP, AIR SILENCER OUTLET ELBOW HOSE . . . 3.2024 A
CLAMP, AMMETER . . . 7.4020 A
CLAMP, BLOWER DRIVE COVER PACKING . . . 3.4227
CLAMP, BREATHER EXTENSION PIPE HOSE . . . 4.8180 A
CLAMP, EXHAUST MANIFOLD FRESH WATER INLET HOSE . . . 5.3434 B
CLAMP, EXHAUST MANIFOLD FRESH WATER OUTLET HOSE . . . 5.3445 B
CLAMP, HEAT EXCHANGER FRESH WATER INLET HOSE . . . 5.3305 B
CLAMP, HEAT EXCHANGER INLET TUBE (INTER) . . . 5.5438 A
CLAMP, HEAT EXCHANGER INLET TUBE INTERMEDIATE . . . 5.5438 A
CLAMP, HEAT EXCHANGER INLET TUBE ((INTERMEDIATE) . . . 5.5438 A

PART NAME GROUP NO.

CLAMP, HEAT EXCHANGER RAW WATER INLET TUBE . . . . . 5.5480 A
CLAMP, HEAT EXCHANGER RAW WATER INLE INLET TUBE HOSE . . . . . 5.5480 A
CLAMP, HEAT EXCHANGER TO WATER PUMP HOSE . . . . . 5.3341 B
CLAMP, HEAT EXCHANGER WATER INLET TUBE . . . . . 5.5441 A
CLAMP, HEAT EXCHANGER WATER INLET TUBE . . . . . 5.5480 A
CLAMP, INJECTOR . . . . . 2.1270 A
CLAMP, INTERCOOLER BY-PASS TUBE . . . . . 5.5741 A
CLAMP, INTERCOOLER INLET TUBE . . . . . 5.5732 A
CLAMP, INTERCOOLER OUTLET TUBE . . . . . 5.5736 A
CLAMP, OIL COOLER WATER INLET . . . . . 4.4214 A
CLAMP, OIL COOLER WATER INLET HOSE . . . . . 4.4214 A
CLAMP, OIL COOLER WATER OUTLET HOSE . . . . . 4.4250 A
CLAMP, OIL PRESSURE GAGE . . . . . 7.4072 A
CLAMP, OIL TEMPERATURE GAGE . . . . . 7.4078 A
CLAMP, RADIATOR INLET HOSE . . . . . 5.3300 B
CLAMP, RADIATOR OUTLET HOSE . . . . . 5.3340 B
CLAMP, RAW WATER PUMP OUTLET TUBE . . . . . 5.5385 A
CLAMP, TACHOMETER . . . . . 7.4065 A
CLAMP, TACHOMETER DRIVE ADAPTOR RETAINING . . . . . 7.4433 B
CLAMP, WATER FILTER INLET HOSE . . . . . 5.7095 A
CLAMP, WATER TEMPERATURE GAGE . . . . . 7.4082 A
CLEVIS, INJECTOR AND EXHAUST VALVE ROCKER ARM 1.8130
CLIP, AIR BOX DRAIN TUBE . . . . . 1.1145 A
CLIP, AIR COMP. WATER TUBE . . . . . 12.4095 A
CLIP, AIR COMPRESSOR BOOSTER INLET TUBE AND ELBOW ASSY . . . . . 12.4377 A
CLIP, AIR COMPRESSOR BOOSTER INLET TUBE AND ELBOW ASSY. . . . . . 12.4377 A
CLIP, AIR COMPRESSOR LUBE OIL TUBE . . . . . 12.4080 A
CLIP, AIR COMPRESSOR LUBE OIL TUBE . . . . . 12.4080 A
CLIP, AIR COMPRESSOR WATER TUBE . . . . . 12.4095 A
CLIP, AIR HEATER INLET AND OUTLET TUBE . . . . . 7.8320 A
CLIP, AIR INLET HOUSING SHUTDOWN CONTROL WIRE . . . . . 3.3270 A
CLIP, AIR SHUT-OFF CONTROL WIRE RESET . . . . . 7.4527 C
CLIP, AIR SHUTOFF CONTROL WIRE (RESET) . . . . . 7.4527 C
CLIP, AIR SHUTOFF CONTROL WIRE (RESET) . . . . . 7.4527 C
CLIP, BATTERY CABLE . . . . . 7.2130 A
CLIP, BREATHER . . . . . 4.8040 A
CLIP, CONVERTER TANK TO PUMP TUBE . . . . . 8.3821 B
CLIP, CONVERTER TO TANK TUBE . . . . . 8.3831 B
CLIP, DIPSTICK . . . . . 4.6040 A
CLIP, EXPANSION TANK OVERFLOW TUBE . . . . . 5.5200 A
CLIP, FILTER TO CYL. HEAD TUBE . . . . . 2.5180 A
CLIP, FILTER TO CYLINDER HEAD TUBE . . . . . 2.5180 A
CLIP, FILTER TO FUEL MANIFOLD TUBE . . . . . 2.5155 A
CLIP, FUEL DRAIN TUBE . . . . . 2.5220 A
CLIP, FUEL PUMP TO FILTER TUBE . . . . . 2.5120 A
CLIP, FUEL PUMP TO FUEL FILTER . . . . . 2.5120 A
CLIP, FUEL SUPPLY TO FUEL STRAINER TUBE . . . . . 2.5020 A
CLIP, FUEL SUPPLY TO STRAINER TUBE . . . . . 2.5020 A
CLIP, FUEL SYSTEM FLEXIBLE HOSE . . . . . 12.9554 B
CLIP, GEAR BOX TO OIL STRAINER TUBE . . . . . 9.1740 A
CLIP, GOVERNOR CONTROL WIRE . . . . . 2.9428 A
CLIP, GOVERNOR CONTROL WIRE TUBE . . . . . 2.9428 A
CLIP, MARINE GEAR OIL LINES . . . . . 4.4345 A
CLIP, OIL COOLER LINES . . . . . 4.4345 A
CLIP, OIL FILTER HOSE . . . . . 8.1992 A
CLIP, OIL FILTER LINE . . . . . 4.3045 A
CLIP, OIL PAN DRAIN TUBE . . . . . 4.7101 A
CLIP, OIL PRESSURE GAGE TUBE . . . . . 7.4076 A
CLIP, OIL SUPPLY TUBE . . . . . 3.5502 A
CLIP, RADIATOR OVERFLOW PIPE . . . . . 5.3170 A
CLIP, STRAINER TO FUEL PUMP TUBE . . . . . 2.5070 A
CLIP, TACHOMETER DRIVE FLEXIBLE SHAFT ASSY . . . . . 7.4412 B
CLIP, TURBOCHARGER OIL RETURN TUBE . . . . . 3.5507 A
CLIP, WATER BY-PASS TUBE . . . . . 5.2190 C
CLIP, WATER CROSSOVER TUBE . . . . . 5.3476 B
CLIP, WIRE HARNESS . . . . . 7.7010 A
CLIP, WIRING HARNESS . . . . . 7.7010 A
CLUTCH ASSEMBLY . . . . . 8.1017 A
CLUTCH ASSY. . . . . . 8.1017 A
CLUTCH, HYDRAULIC STARTER DRIVE . . . . . 12.6506 D
COIL ASSY., AIR HEATER . . . . . 7.8080 A
COLLAR, BLOWER HOUSING END PLATE SEAL RING 3.4159
COLLAR, CLUTCH RELEASE . . . . . 8.1295 A
COLLAR, GOVERNOR DRIVE SHAFT . . . . . 2.6620 A
COLLAR, THROTTLE CONTROL LEVER . . . . . 2.5643 A
COLLAR, TURBOCHARGER ROTOR THRUST . . . . . 3.5034 A
COMPRESSOR ASSY., AIR . . . . . 12.4001 A
CONE, CRANKSHAFT PULLEY . . . . . 1.3295 C
CONE, POWER TAKE-OFF ADAPTOR . . . . . 8.1907 A
CONE, VIBRATION DAMPER FRONT . . . . . 1.3240 B
CONE, VIBRATION DAMPER REAR . . . . . 1.3250 B
CONNECTING ROD ASSY. 1.6001
CONNECTION, EXPANSION TANK OUTLET . . . . . 5.3311 B
CONNECTION, FLEXIBLE EXHAUST . . . . . 6.2055 A
CONNECTION, GOVERNOR TACHOMETER SHAFT . . . . . 8.3475 A
CONNECTION, HEAT EXCHANGER INLET . . . . . 5.3314 B
CONNECTION, HEAT EXCHANGER WATER OUTLET . . . . . 5.3312 B
CONNECTION, INTERCOOLER WATER . . . . . 3.5434 A
CONNECTION, OIL COOLER WATER INLET . . . . . 4.4211 A
CONNECTION, RADIATOR INLET . . . . . 5.2270 B
CONNECTION, RADIATOR OUTLET . . . . . 5.3310 B
CONNECTOR, BILGE PUMP PRIMING TUBE . . . . . 12.2220 A
CONNECTOR, BREATHER TUBE . . . . . 4.8021 A
CONNECTOR, EXHAUST MANIFOLD FRESH WATER INLET . . . . . 5.3430 B
CONNECTOR, EXHAUST RESTRICTOR . . . . . 6.2131 A
CONNECTOR, FUEL LINE TO BASE . . . . . 11.1240 A
CONNECTOR, FUEL PIPE 2.4030
CONNECTOR, TURBOCHARGER EXHAUST INLET . . . . . 3.5305 A
CONTACT, AUTOMATIC STARTING . . . . . 7.2292 B
CONTAINER, INJECTOR SHIPPING . . . . . 2.1010 A
CONTROL ASSY., MASTER THROTTLE AND REVERSE GEAR . . . . . 2.9634 A
CONTROL ASSY., VERNIER THROTTLE . . . . . 2.9133 A

PART NAME — GROUP NO.

CONTROL, MASTER THROTTLE AND REVERSE GEAR OPERATING . . . 2.9625 A
CONTROL, VERNIER THROTTLE . . . 2.9133 A
CONTROLLER, TURBOCHARGER PRESSURE RATIO . . . 3.5700 A
CONVERTER ASSY., TORQUE . . . 8.3001 A
COOLER ASSY. (COMPLETE) . . . 4.4005 A
COOLER ASSY., FUEL . . . 2.5212 A
CORE ASSY., RADIATOR . . . 5.3010 A
CORE, HEAT EXCHANGER . . . 5.5003 A
CORE, INTERCOOLER . . . 3.5433 A
CORE, MARINE GEAR OIL COOLER . . . 4.4002 A
CORE, OIL COOLER . . . 4.4001 A
COUPLING ASSY., POWER TAKE-OFF . . . 8.1910 A
COUPLING, ACCESSORY DRIVE . . . 1.7635 B
COUPLING, AIR COMP. DRIVE . . . 12.4050 A
COUPLING, AIR COMPRESSOR DRIVE . . . 12.4050 A
COUPLING, BLOWER DRIVE . . . 3.4370
COUPLING, ENGINE DRIVE SHAFT FLEXIBLE . . . 1.4060 A
COUPLING, ENGINE DRIVE SHAFT FLEXIBLE . . . 1.4060 A
COUPLING, FUEL PUMP DRIVE . . . 2.2230
COUPLING, GEAR BOX OUTPUT SHAFT . . . 9.3055 A
COUPLING, GENERATOR DRIVE . . . 7.1560 A
COUPLING, HYDRAULIC PUMP DRIVE . . . 9.1553 A
COUPLING, HYDRAULIC PUMP DRIVE . . . 12.5010 A
COUPLING, PROPELLER DRIVE SHAFT . . . 9.1440 A
COUPLING, RAW WATER PUMP DRIVE . . . 5.6420 A
COUPLING, THROTTLE CONTROL SHAFT . . . 2.9190 A
COVER ASSY., DRAIN TANK . . . 1.1160 A
COVER ASSY., GOV. (COMPLETE) . . . 2.7045 A
COVER ASSY., GOVERNOR (COMPLETE) . . . 2.7045 A
COVER ASSY., GOVERNOR (LESS SHAFT AND LEVERS) . . . 2.7050 A
COVER ASSY., ROCKER . . . 1.8450 A
COVER KIT, BLOWER END PLATE . . . 3.4180
COVER, ACCESSORY DRIVE HOLE . . . 1.7490 A
COVER, AIR COMPRESSOR . . . 12.4385 A
COVER, AIR COMPRESSOR MISCELLANEOUS . . . 12.4385 A
COVER, AIR SHUT-OFF CONTROL HOUSING . . . 7.4553 C
COVER, AIR SHUTOFF CONTROL HOUSING . . . 7.4553 C
COVER, AIR SILENCER . . . 3.2003 A
COVER, BALANCE WEIGHT . . . 1.7470 A
COVER, BLOWER HOUSING END PLATE . . . 3.4180
COVER, BLOWER HSG. END PLATE . . . 3.4180
COVER, CLUTCH HOUSING INSPECTION HOLE . . . 8.1060 A
COVER, COOLER BY-PASS HOLE . . . 4.4182 A
COVER, CRANKSHAFT FRONT . . . 1.3160 A
COVER, CRANKSHAFT FRONT COVER LARGE HOLE . . . 1.3197 A
COVER, CRANKSHAFT FRONT COVER SMALL HOLE . . . 1.3195 A
COVER, CYLINDER BLOCK HAND HOLE . . . 1.1040
COVER, CYLINDER BLOCK OIL HOLE . . . 1.1065
COVER, CYLINDER BLOCK WATER HOLE . . . 1.1060
COVER, CYLINDER HEAD ENGINE LIFTER BRACKET . . . 1.2085 A
COVER, CYLINDER HEAD GOVERNOR HOLE . . . 1.2050
COVER, EXPANSION TANK . . . 5.5020 A
COVER, FAST IDLE AIR CYLINDER . . . 2.7855 A
COVER, FAST IDLER AIR CYLINDER . . . 2.7855 A
COVER, FLYWHEEL HOUSING ADAPTOR HOLE . . . 1.5145 B
COVER, FLYWHEEL HOUSING INSPECTION HOLE . . . 1.5080 A
COVER, FLYWHEEL HOUSING LARGE HOLE . . . 1.5030 A
COVER, FLYWHEEL HOUSING SMALL HOLE . . . 1.5050 A
COVER, FORWARD CLUTCH DUMP VALVE SPRING . . . 9.1275 A
COVER, FORWARD CLUTCH DUMP VALVE SPRING . . . 9.1275 A
COVER, FRESH WATER PUMP BODY . . . 5.1031
COVER, FUEL FILTER . . . 2.3390 A
COVER, FUEL PUMP . . . 2.2030
COVER, FUEL STRAINER . . . 2.3080 A
COVER, GEAR BOX HOUSING . . . 9.3260 A
COVER, GEAR BOX OUTPUT SHAFT BEARING . . . 9.3055 A
COVER, GOVERNOR . . . 2.8040 A
COVER, GOVERNOR CONTROL LINK HOUSING . . . 2.7858 A
COVER, GOVERNOR FUEL ROD SPRING . . . 2.8085 A
COVER, GOVERNOR HIGH SPEED SPRING . . . 2.7630 A
COVER, HEAT EXCHANGER . . . 5.5030 A
COVER, HYDRAULIC CONTROL VALVE . . . 9.1178 A
COVER, HYDRAULIC PUMP . . . 9.1450 A
COVER, HYDRAULIC STARTER END . . . 12.6543 D
COVER, INSTRUMENT PANEL . . . 7.4012 A
COVER, MASTER CYLINDER RESERVOIR . . . 12.6812 F
COVER, OIL COOLER ADAPTOR . . . 4.4116 A
COVER, OIL COOLER BY-PASS HOLE . . . 4.4182 A
COVER, OIL COOLER HOUSING . . . 4.4060 A
COVER, OIL FILTER . . . 4.2290 A
COVER, OIL FILTER RETURN HOLE . . . 4.4082 A
COVER, OIL LINE FLANGE . . . 9.1186 A
COVER, OIL PAN . . . 4.7120 A
COVER, OIL PUMP . . . 4.1220 A
COVER, OIL PUMP INLET SCREEN . . . 4.1550 B
COVER, OIL PUMP PAD . . . 4.1250 A
COVER, OIL STRAINER . . . 9.1675 A
COVER, OIL TANK HAND HOLE . . . 8.3845 B
COVER, OIL TANK HAND HOLE . . . 11.1260 A
COVER, OVERSPEED TRIP GOVERNOR HOUSING . . . 7.4630 C
COVER, OVERSPEED VALVE . . . 7.4729 C
COVER, RAW WATER PUMP . . . 5.6050 A
COVER, REDUCTION GEAR BEARING . . . 9.1365 A
COVER, STARTING MOTOR HOLE . . . 1.5070 A
COVER, TACHOMETER . . . 7.4445 B
COVER, TACHOMETER DRIVE . . . 7.4445 B
COVER, THERMOSTAT HOUSING . . . 5.2120 B
COVER, VERNIER THROTTLE CONTROL . . . 2.9149 A
COVER, WATER FILTER . . . 5.7034 A
CRANKSHAFT ASSY. . . . 1.3001
CUP, AIR CLEANER . . . 3.1010 A
CUP, BILGE PUMP GREASE . . . 12.2130 A
CUP, ENGINE MOUNTING BASE ISOLATION PAD . . . 11.1020 A
CUP, OIL PUMP RELIEF VALVE SPRING RETAINING . . . 4.1275 A
CUSHION, AIR HEATER ACCUMULATOR MOUNTING . . . 7.8417 A
CUSHION, ENGINE MOUNTING ISOLATION PAD . . . 11.1010 A
CUT CUT ASSY., GENERATOR ASSY., VOLTAGE . . . 7.1607 A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2.8976
2.8981
2.8981
2.8981
2.8970
2.8979
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2.8977
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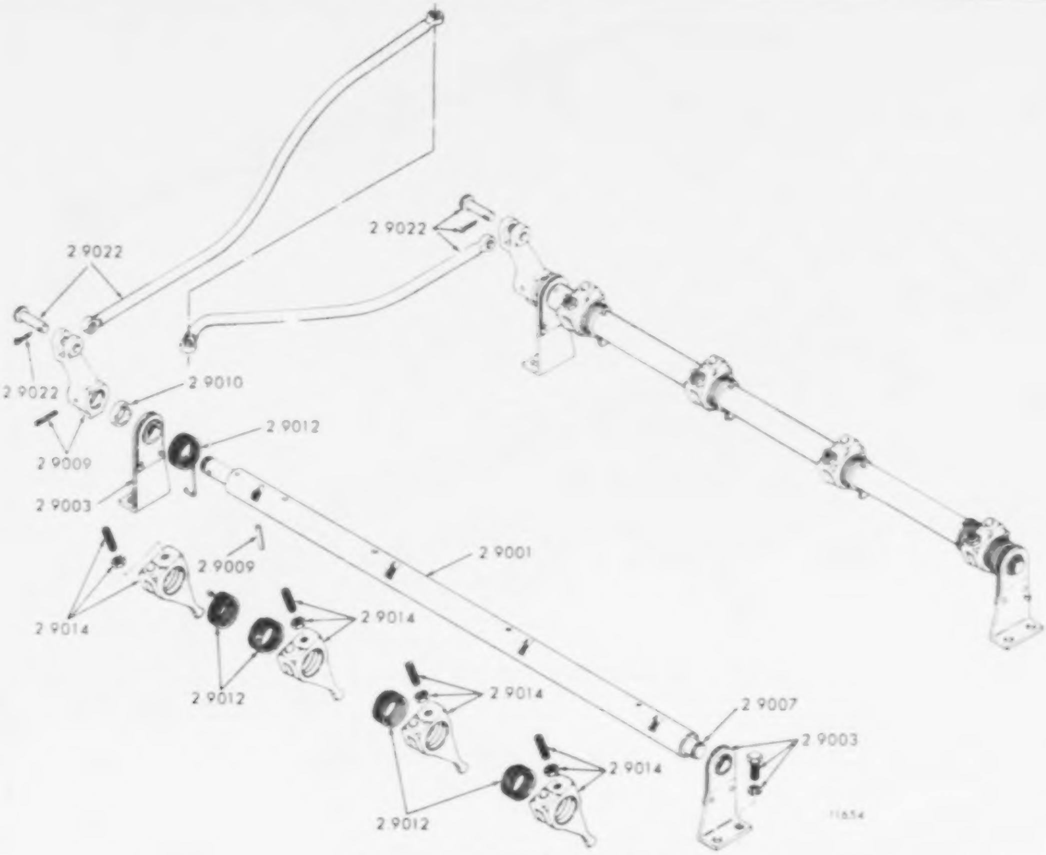
2.8979
2.8977
2.8983
2.8970
2.8976
2.8976
2.8973
2.8973
2.8977
2.8980
2.8973
2.8982
2.8780
2.8811
2.8035
2.8780
2.8950
2.8945
2.8780
2.878C
2.8811
2.6750
2.8750
2.8945
2.9022
2.8965
2.8965
2.8965*
2.8950
2.8945
2.9022
P467

*NOT SERVICED SEPARATELY

FIG. 6F GOVERNOR DRIVE (Hydraulic Limiting Speed, Front)

best copy available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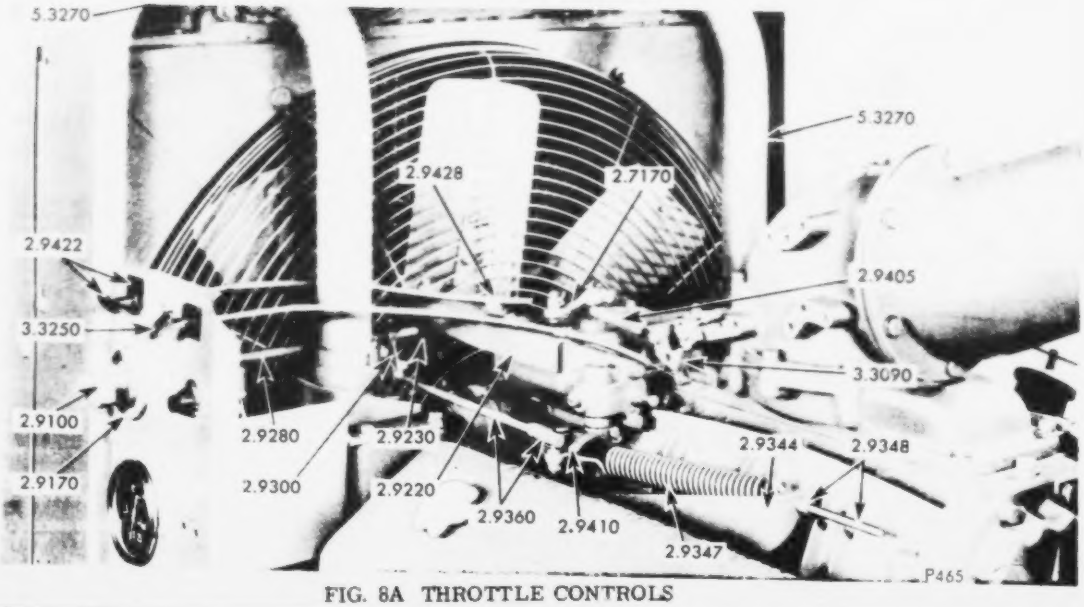
2.9022
2.9022
2.9010
2.9012
2.9009
2.9003
2.9009
2.9001
2.9014
2.9014
2.9012
2.9014
2.9007
2.9003
2.9014
2.9012
11654

FIG. 7D INJECTOR CONTROLS
(Spring Loaded)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2.7170
2.9422
2.9405
3.3250
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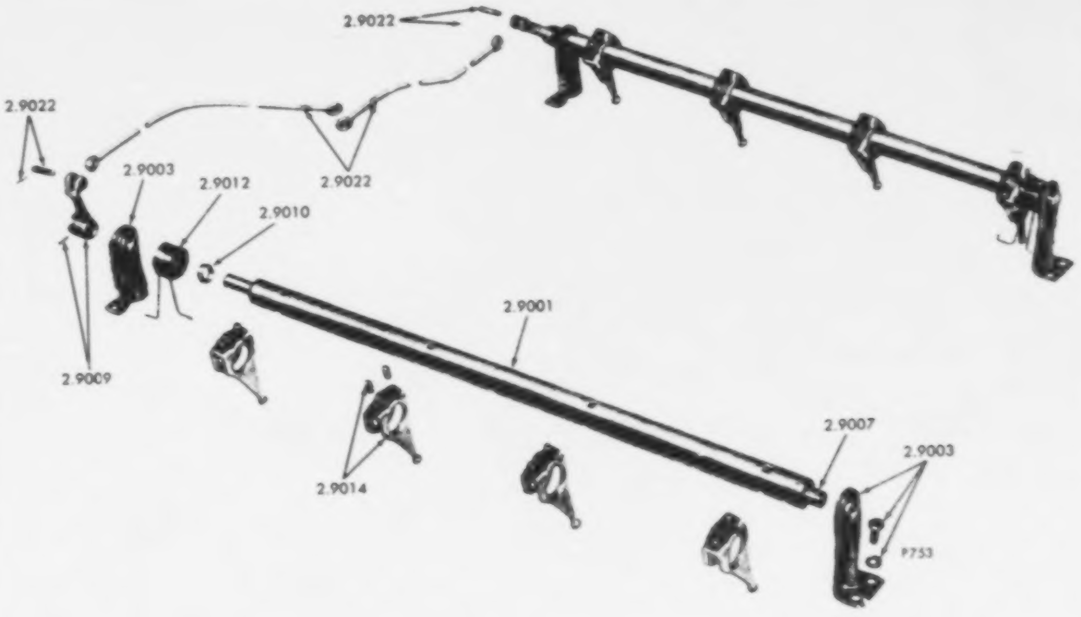
2.9100
2.9280
2.9230
2.9344
2.9348
2.9170
2.9300
2.9220
2.9360
2.9410
2.9347
P465

FIG. 8A THROTTLE CONTROLS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2.9003
2.9012
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2.9007
2.9003
2.9014
P753

FIG. 7A INJECTOR CONTROLS

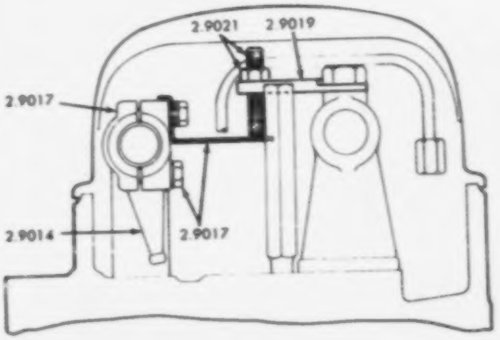

2.9021
2.9019
2.9017
2.9017
2.9014
2.9017

FIG. 7B POWER CONTROL

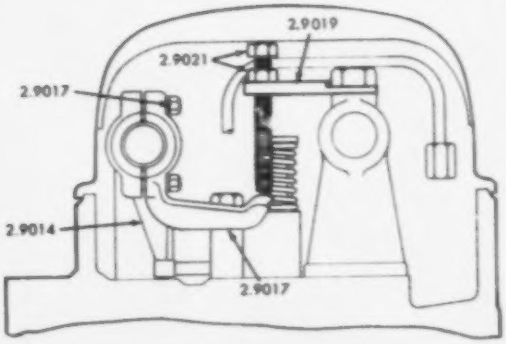
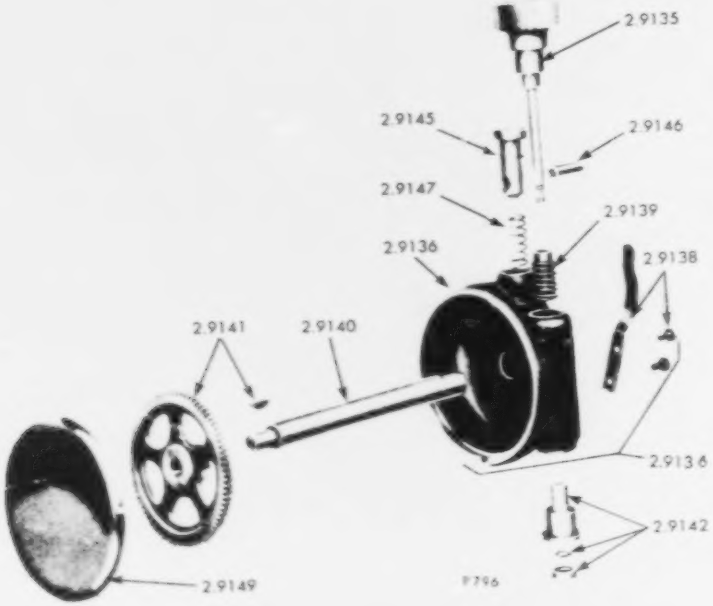

2.9019
2.9021
2.9017
2.9014
2.9017

FIG. 7C TORQUE LIMIT CONTROL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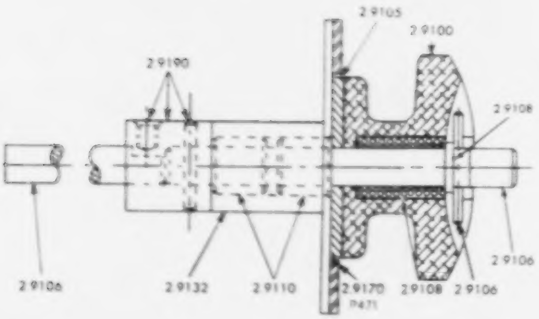
2.9146
2.9147
2.9139
2.9136
2.9138
2.9141
2.9140
2.9136
2.9142
2.9149
P796

FIG. 8B VERNIER THROTTLE CONTROL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2.9190
2.9108
2.9106
2.9106
2.9132
2.9110
2.9170
P471
2.9108
2.9106
2.9106

FIG. 8C THROTTLE CONTROL

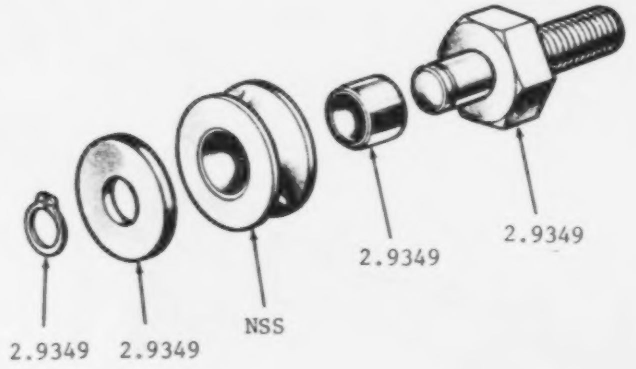
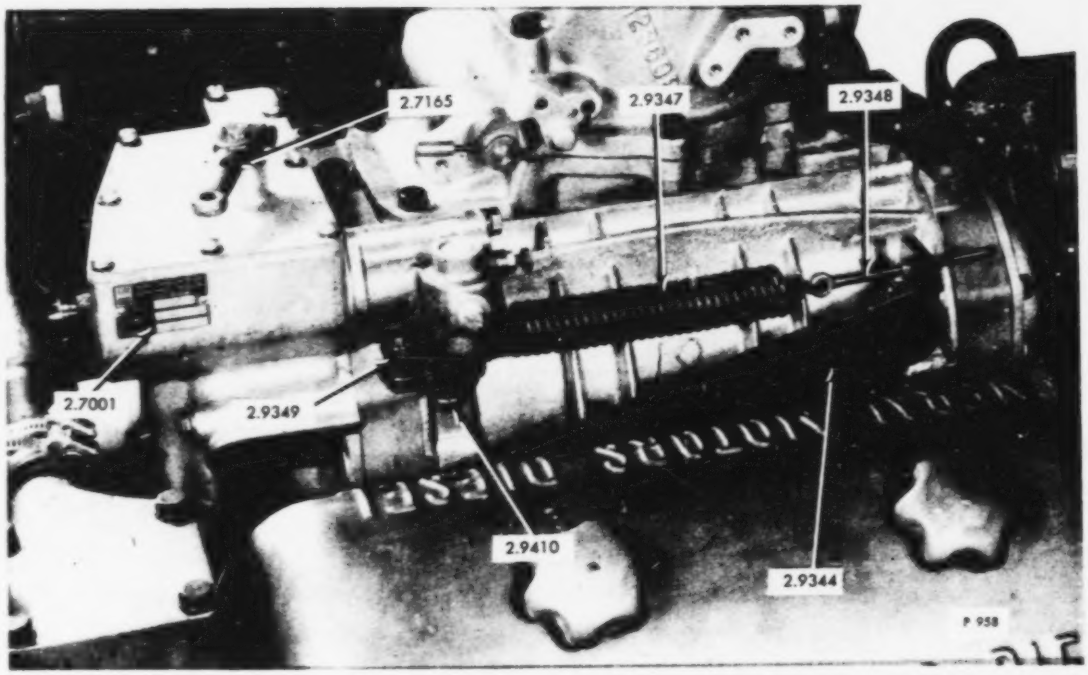

2.9349
2.9349
NSS
2.9349
2.9349

FIG. 8D HANGER ASSY.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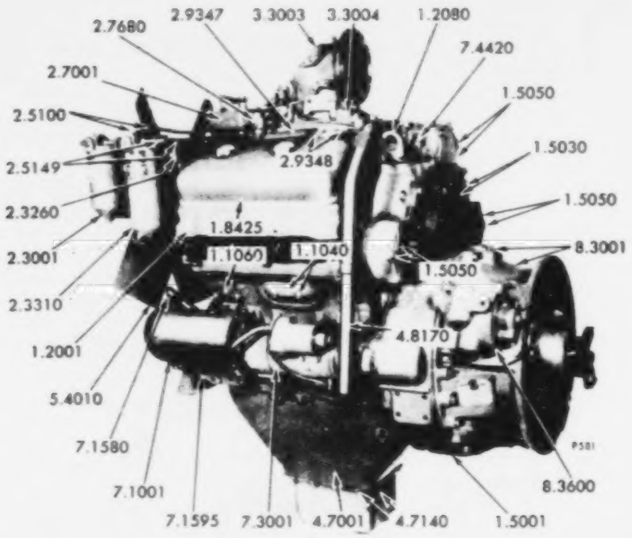
2.9347
2.9348
2.7001
2.9349
2.9410
2.9344
P 958

FIG. 8E THROTTLE CONTROLS, VARIABLE SPEED GOVERNOR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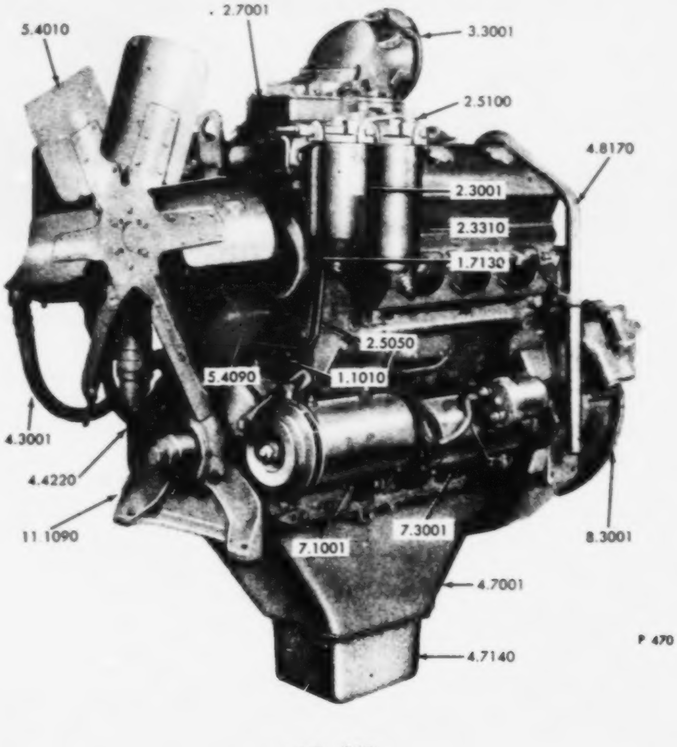
3.3003
3.3004
1.2080
7.4420
2.7001
1.5050
2.5100
1.5030
2.5149
2.9348
2.3260
1.5050
1.8425
8.3001
2.3001
1.1060
1.1040
1.5050
2.3310
4.8170
1.2001
5.4010
7.1580
P501
8.3600
7.1001
7.1595
7.3001
4.7001
4.7140
1.5001

FIG. 10A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3.3001
2.5100
4.8170
2.3001
2.3310
1.7130
2.5050
5.4090
1.1010
4.3001
4.4220
11.1090
7.3001
7.1001
8.3001
4.7001
P 470
4.7140

FIG. 10B

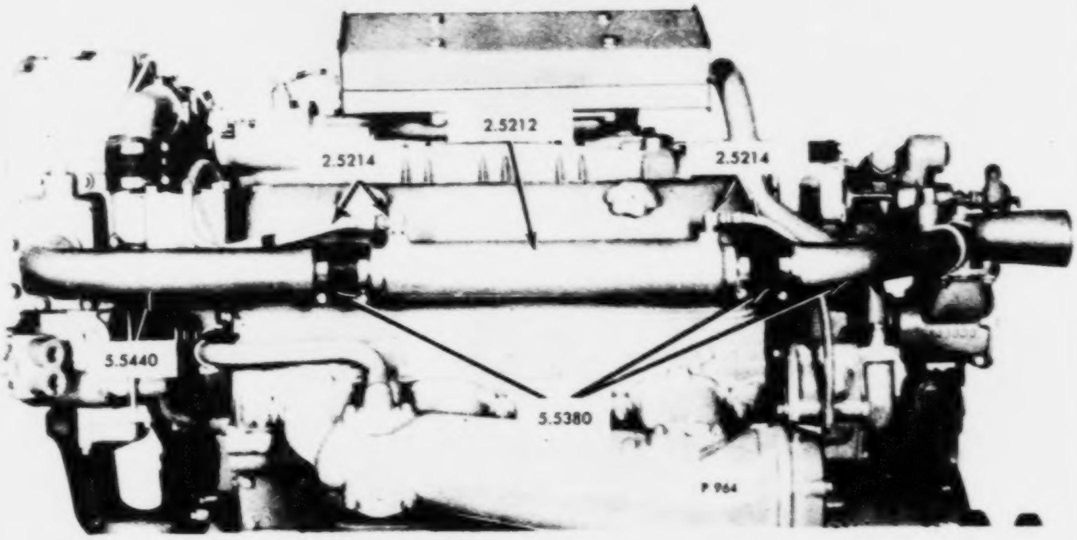

2.5212
2.5214
2.5214
5.5440
5.5380
P 964

FIG. 10C FUEL COOLER

2.1000A FUEL INJECTOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	92	97	100	115	127
		2.1001 - INJECTOR ASSY.					
		QUANTITIES SHOWN ARE (1) PER CYLINDER. INCLUDES ITEMS IN 2.1020 THRU 2.1265.					
1A	5228850	* INJECTOR ASSY. (71N5)	1				
1B	5228900	* INJECTOR ASSY. (N65)		1			
1B	5228790	* INJECTOR ASSY. (N90)			1		
1B	5229365	* INJECTOR ASSY. (C65)				1	
1B	5229495	* INJECTOR ASSY. (140)					1
		* INCLUDES ONE FILTER ELEMENT AT INLET SIDE ONLY.					
		2.1002 - SERVICE KIT, INJECTOR					
		CONSISTS OF ONE (1) SEAL RING, TWO (2) FILTER CAP GASKETS, TWO (2) FILTER ELEMENTS AND TWO (2) SHIPPING CAPS.					
	5229649	SERVICE KIT	AR	AR	AR	AR	AR
		2.1010 - CONTAINER, INJECTOR SHIPPING					
1A	5153171	CONTAINER (12.8050)	AR	AR	AR	AR	AR
		2.1020 - BODY ASSY., INJECTOR					
1B	5228583	BODY ASSY. (INCLUDES DOWEL AND PLUGS)	1	1	1	1	1
1A,B	5226416	DOWEL	1	1	1	1	1
	5226512	PLUG, BODY				1	1
1B	5228829	TAG, NUMBER (71N5)	1				
1B	5228848	TAG, NUMBER (N65)		1			
1B	5229191	TAG, NUMBER			1		
1B	5229089	TAG, NUMBER				1	
	5229018	TAG, NUMBER					1
		2.1030 - NUT, INJECTOR VALVE					
1B	5228601	NUT	1	1	1	1	1
		2.1040 - RING, INJECTOR SEAL					
1A,B	5229167	RING	1	1	1	1	1

2.1000A FUEL INJECTOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	92	97	100	115	127
	2.1050	DEFLECTOR, INJECTOR SPILL					
1A,B	5228109	DEFLECTOR	1	1	1	1	1
	2.1060	FOLLOWER, INJECTOR					
1A,B	5228104	FOLLOWER	1	1	1	1	1
	2.1080	SPRING, INJECTOR PLUNGER					
1A,B	5228739	SPRING	1	1	1	1	
1A,B	5229518	SPRING					1
	2.1100	PIN, INJECTOR STOP					
1B	5228608	PIN	1	1	1	1	1
	2.1110	ELEMENT, INJECTOR FILTER					
1B	5228587	ELEMENT	1	1	1	1	1
	2.1130	CAP, INJECTOR FILTER					
1B	5228588	CAP	2	2	2	2	2
	2.1140	GASKET, INJECTOR FILTER CAP					
1A,B	5226186	GASKET	2	2	2	2	2
	2.1160	PLUNGER & BUSHING ASSY., INJECTOR					
		PLUNGERS AND BUSHINGS ARE NOT SOLD SEPARATELY. AN ASSY. INCLUDES PIN IN 2.1165.					
	5228749	PLUNGER AND BUSHING ASSY. (71NS) . . .	1				
1B	5228928	PLUNGER AND BUSHING ASSY. (N65) . . .		1			
1B	5228878	PLUNGER AND BUSHING ASSY. (N90) . . .			1		
1B	5229366	PLUNGER AND BUSHING ASSY. (C65) . . .				1	
1B	5229513	PLUNGER AND BUSHING ASSY.					1
	2.1165	PIN, BUSHING GUIDE					
	5226393	PIN	1	1	1	1	1

FIG.	PART NUMBER	NAME AND DESCRIPTION	92	97	TYPES		
					100	115	127
		2.1170 - RACK, INJECTOR					
1A,B	5226719	RACK ASSY.	1	1	1	1	1
		2.1180 - GEAR, INJECTOR					
1A,B	5226400	GEAR	1	1		1	
1A,B	5228802	GEAR			1		1
		2.1190 - RETAINER, INJECTOR GEAR					
1B	5228586	RETAINER	1	1	1	1	1
		2.1200 - VALVE, INJECTOR CHECK					
1B	5228654	VALVE	1	1	1	1	1
		2.1205 - CAGE, INJECTOR CHECK VALVE					
1B	5228656	CAGE	1	1	1	1	1
		2.1235 - TIP ASSY., INJECTOR SPRAY					
		COMPONENTS OF TIP ASSY. ARE NOT SOLD SEPARATELY.					
1B	5229026	TIP ASSY. (71N5)	1				
1B	5229030	TIP ASSY. (N65)		1			
1B	5229256	TIP ASSY. (N90)			1		
1B	5229192	TIP ASSY. (C65)				1	
1B	5229516	TIP ASSY.					1
		2.1238 - VALVE KIT, INJECTOR					
	5228769	VALVE KIT (INCLUDES ITEMS IN 2.1250 AND 2.1255)	AR	AR	AR	AR	AR
		2.1250 - SPRING, INJECTOR VALVE					
1B	5228596	SPRING	1	1	1	1	1
		2.1255 - SEAT, INJECTOR VALVE SPRING					
1B	5228766	SEAT	1	1	1	1	1

2.1000A FUEL INJECTOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	92	97	100	115	127
		2.1257 - CAGE, INJECTOR VALVE SPRING					
1B	5228594	CAGE	1	1	1	1	1
		2.1270 - CLAMP, INJECTOR					
1A,B	5121259	CLAMP	1	1	1	1	1
1A,B	179847	BOLT, 3/8 -16X2 (12.9001)	1	1	1	1	1
1A,B	5150250	WASHER	1	1	1	1	1

2.2000 FUEL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 126	146	150	153	154	157
		2.2001 - PUMP ASSY., FUEL						
		SEE ASSEMBLY BREAKDOWN AS INDICATED BELOW. A FUEL PUMP KIT INCLUDES A 3/8 INLET PLMP, GASKET IN 2.2007 AND REDUCING BUSHING IN 2.2030.						
2A	5146343	# PUMP ASSY. (L.H.) 3/8 INLET HIGH CAPACITY (PAGE A3)		1				
2A	5146703	# PUMP ASSY. (L.H.) 3/8 HIGH CAPACITY (PAGE A3)				1		
2A	5146700	PUMP ASSY. (L.H.) (3/8 INLET HIGH CAPACITY (PAGE A3)					1	
2A	5146699	PUMP ASSY. (L.H.) CAPACITY (PAGE A3)						1
	5199560	PUMP KIT, FUEL (PAGE A1)	1					
	5199735	PUMP KIT, FUEL (PAGE A3)		1				
	5199562	PUMP KIT, FUEL (PAGE A1)			1			
	5199733	PUMP KIT, FUEL (PAGE A3)				1		
	5145009	PLUG, 1/8 PIPE (12.9550)	2	2	2	2	2	1
	5145014	PLUG, 3/8 PIPE (12.9550)		1	1	1	1	
	5131686	BOLT 5/16"-18x3/4" NY INS.	3	3	3	3	3	3
		# NOT SERVICED COMPONENTS ARE AVAILABLE. FOR COMPLETE REPLACEMENT USE PUMP KIT SHOWN IN SAME TYPE.						
		2.2004 - OVERHAUL KIT, FUEL PUMP						
	5195078	@ OVERHAUL KIT	1		1			
	5196938	@ OVERHAUL KIT		1		1	1	
		@ INCLUDES PLUGS IN 2.2001 PLUS ITEMS IN 2.2007, 2.2070, 2.2087, 2.2089, 2.2093, 2.2130, 2.2160 AND 2.2180.						
		2.2007 - GASKET, FUEL PUMP TO ENGINE						
2A	5150193	GASKET (5.1010)	1	1	1	1	1	1
		2.2220 - FORK, FUEL PUMP COUPLING						
2A	5102257	FORK	1	1	1	1	1	1

2.200C FUEL PUMP

2.2001 - PUMP ASSY., FUEL

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		A FUEL PUMP KIT INCLUDES A 3/8 INLET PUMP IN 2.2001, GASKET IN 2.2C07 PLUS REDUCING BUSHING IN 2.2030.														
2A	5199560	PUMP KIT (A, B ENG.)		1												
2A	5184531	# PUMP ASSY. (A,B ENG.) GEAR TYPE (5199560)	1													
2A	5134705	# PUMP ASSY. (A,B ENG.) GEAR TYPE (5199560)														
2A	5199562	PUMP KIT, FUEL (A,B ENG.)				1										
2A	5111366	# PUMP ASSY. (A,B ENG.) GEAR TYPE (5199562)			1											
2A	5134715	# PUMP ASSY. (A,B ENG.) GEAR TYPE (5199562)				1										
2A	5128213	& PUMP ASSY. (L.H.) HIGH CAPACITY (5146343)					1									
	5100307	# PUMP ASSY. (L.H.) HIGH CAPACITY (5146703)						1								
	5100305	& PUMP ASSY. (L.H.) HIGH CAPACITY (5146343)							1							
2A	5110760	PUMP ASSY. (PRIMER) (12.6655)								1						
	5134704	# PUMP ASSY. (L.H.) HIGH CAPACITY (5146700)									1					
2A	5134701	# PUMP ASSY. (L.H.) HIGH CAPACITY (5146699)										1				
		# ASSEMBLY NOT SERVICED, USE PUMP ASSY. SHOWN IN PARENTHESES.														
		& NOT SERVICED, USE PUMP ASSY. SHOWN IN PARENTHESES PLUG (1) 5145009 PLUG														
	5136240	PLUG, .42" DIA.		1												
	5136241	PLUG, .58" DIA.		1												

2.2007 - GASKET, FUEL PUMP TO ENGINE

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
2A	5150193	% GASKET (5.1010)				1										
		% PART OF FUEL PUMP KITS IN 2.2001.														

2.2010 - BODY, FUEL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
2A	5146337	BODY														
2A	5135049	+ BODY (LUBRITED) (5146682)	1	1	1	1										
2A	5100311	+ BODY (5146339)										1				
2A	5128827	# BODY ASSY. (5199735)					1	1	1		1					
2A	141195	PIN, 1/4 X5/8 DOWEL (12.9290)	1	2	1	1		1	1		1	2				
		+ NOT SERVICED, USE BODY SHOWN IN PARENTHESES AND INCLUDE 1-5145009 PLUG.														

2.2000 FUEL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		2.2010 - BODY, FUEL PUMP (CONT'D)														
		# ASSEMBLY NOT SERVICED, USE PUMP ASSY. SHOWN IN PARENTHESES.														
		2.2030 - COVER, FUEL PUMP														
2A	5174962	= COVER	1		1											
2A	5128219	# COVER (5146342)					1									
2A	5100301	COVER						1	1							
2A	5134560	COVER		1		1					1					
2A	5134708	COVER										1				
	5198558	% BUSHING, 3/8 X1/4 RED.	1		1											
	3715219	BOLT, 1/4 -20X3/4 (INCLUDES LOCKWASHER)	8	8	8	8	8	8	8		8	8				
	179803	BOLT, 1/4 -20X1 3/4 (12.9001)					4	4	4							
2A	120380	LOCKWASHER, 1/4 (12.9200)					4	4	4							
		= NOT SERVICED, USE 5134560 AND INCLUDE 1-5198558 REDUCING BUSHING IN 2.2030 TO ASSURE INTERCHANGEABILITY. % PART OF FUEL PUMP KITS IN 2.2001.														
		2.2035 - VALVE ASSY., FUEL PUMP CHECK														
	5134673	BALL, 1/4 NYLON (2.2130)										1				
	9417463	PIN (12.9275)										1				
	5134674	PLUG, 3/8 SPECIAL (2.2170)										1				
	5152148	WASHER, 3/8 X9/16 SEAL (2.4050)										1				
		2.2070 - SEAL, FUEL PUMP OIL														
2A	5230007	SEAL	2	2	2	2	2	2	2		2	2				
	5199460	* SEAL (RING) (12.6656)								2						
		* NO LONGER AVAILABLE FOR SERVICE.														
		2.2087 - GEAR, FUEL PUMP (DRIVE)														
	5174975	GEAR	1	1	1	1										
	5128217	GEAR					1	1	1		1	1				
	147481	BALL, 1/8 DIA. STEEL (12.9670)	1	1	1	1	1	1	1	1	1	1				
		2.2088 - GEAR, FUEL PUMP DRIVEN														
2A	5124529	* GEAR					1									
		* NO LONGER AVAILABLE FOR SERVICE.														

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	2.2089 -	SHAFT, FUEL PUMP DRIVEN														
		A SHAFT ASSY. INCLUDES GEAR WHICH IS NOT SOLD SEPARATELY.														
2A	5181747	SHAFT ASSY.	1	1	1	1										
2A	5100313	SHAFT ASSY.						1	1		1					
	5135040	SHAFT ASSY.										1				
	2.2093 -	SHAFT, FUEL PUMP														
		A SHAFT ASSY. INCLUDES SHAFT IN 2.2093 AND ITEMS IN 2.2087.														
2A	5178700	SHAFT (DRIVE)	1	1	1	1										
2A	5118919	@ SHAFT (DRIVE)					1									
	5108444	SHAFT						1	1		1	1				
2A	5181746	SHAFT ASSY. (DRIVE)	1	1	1	1										
2A	5135039	SHAFT ASSY. (DRIVE)										1				
2A	5128216	@ SHAFT ASSY. (DRIVE)					1									
2A	5100314	SHAFT ASSY. (DRIVE)						1	1		1					
		@ NOT SERVICED CONVERT TO 5146704 FUEL PUMP FOR R.H. OR 5199735 FUEL PUMP FOR L.H.														
	2.2130 -	VALVE, FUEL PUMP														
2A	5174973	VALVE	1	1	1	1	1	1	1		1	1				
2A	103709	PIN, 5/32 X1 STRAIGHT (12.9300)	1	1	1	1	1	1	1		1	1				
	2.2160 -	SPRING, FUEL PUMP VALVE RETAINING														
2A	5184530	SPRING	1	1	1	1	1	1	1		1	1				
	9022571	* SPRING (CHECK VALVE) (12.6662)								1						
	5199459	* SPRING (PLUNGER) (12.6657)								1						
		* NO LONGER AVAILABLE FOR SERVICE.														
	2.2170 -	PLUG, FUEL PUMP VALVE														
2A	5174971	PLUG	1	1	1	1	1	1	1		1	1				
	2.2180 -	GASKET, FUEL PUMP VALVE PLUG														
2A	5161003	GASKET	1	1	1	1	1	1	1		1	1				

2.3000A FUEL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 288	290	298	314	338	343	344	348	356	360	363	365
		2.3001 - STRAINER ASSY., FUEL												
		SEE ASSEMBLY BREAKDOWN PAGE A1.												
4A,10B	5575570	STRAINER ASSY. (T-66)	1	1										
4A,10B	5575824	STRAINER ASSY. (T-67)			1	1			1					
4A,10B	6436075	@ STRAINER ASSY. (T-74)						1		1	1	1	1	1
2B	6438839	CARTRIDGE, FUEL STRAINER (SPIN-ON)					1	1		1	1	1	1	1
2B	5148023	COVER, FUEL STRAINER (SPIN-ON)					1	1		1	1	1	1	1
	5164789	* SPACER (5.4025)												2
	103647	DRAINCOCK, 1/4 (12.9510)	1											
	5574921	DECAL	1	1	1									
	5575062	DECAL			1	1			1					
	6436060	@ DECAL						1		1	1	1	1	1
	6439603	DECAL, FUEL STRAINER (SPIN-ON)					1	1		1	1	1	1	1
4A	180121	BOLT, 3/8 -16X7/8 (12.9001)				1								
4A	186679	BOLT, 3/8 -16X1 1/4 (12.9001)									2	2		2
4A	454906	BOLT, 3/8 -16X1 1/2 (12.9001)				1								
4A	179844	BOLT, 3/8 -16X1 5/8 (12.9001)												2
4A	181370	BOLT, 3/8 -24X1 1/4 (12.9001)							2				2	
4A	103321	LOCKWASHER, 3/8 (12.9200)	AR						2		2	2	2	4
4A	102635	NUT, 3/8 -16 HEX. (12.9120)	2								2	2		
4A	117049	NUT, 3/8 -24 HEX. (12.9120)							2				2	
		@ THRU 6VA-67342, 8VA-202807, 12VA-30149.												
	5145014	PLUG, 3/8" PIPE (12.9550)					2							
		* USE ONLY WHEN 5128202 COVER IN 4.4060 IS SPECIFIED.												
		2.3165 - STRAP, FUEL STRAINER MOUNTING												
	5127156	STRAP	4	4										
	132430	SCREW, 3/8 -16X2 1/2 FIL. HD. (12.9010)	4	4										
	120382	LOCKWASHER, 3/8 (12.9200)	2	4										
	102635	NUT, 3/8 -16 HEX. (12.9120)	2	4										
		2.3260 - BRACKET, FUEL STRAINER MTG.												
	5162903	BRACKET (STRAINER AND FILTER)									1			
#	5122693	BRACKET (STRAINER AND FILTER)	1											
4A	5129065	BRACKET (FUEL FILTER)		1										
4A	5129066	BRACKET (FUEL FILTER)		1										
4A	5133288	BRACKET (2.3530)			1									
4A	5130169	* BRACKET				1								
4A	5135326	BRACKET							1				1	
	3292558	SPACER (5.4600)											3	
	5170765	SPACER, 11/32 X21/32 (7.1581)							3					

2.3000A FUEL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	288	290	298	314	338	343	344	348	356	360	363	365
		2.3260 - BRACKET, FUEL STRAINER MTG. (CONT'D)												
	5183914	SPACER, 11/32 X1 11/32 (1.7625)											3	
4A	179816	BOLT, 5/16 -18X3/4 (12.9001)									2			
4A	215404	BOLT, 5/16 -18X5 3/4 (12.9001)							3					
4A	446597	BOLT, 5/16 -18X6 1/2 (12.9001)											3	
4A	180121	BOLT, 3/8 -16X7/8 (12.9001)	4											
4A	179839	BOLT, 3/8 -16X1 (12.9001)		4										
4A	181370	BOLT, 3/8 -24X1 1/4 (12.9001)			2	1								
4A	181374	BOLT, 3/8 -24X1 1/2 (12.9001)		4										
4A	103341	WASHER, 3/8 FLAT (12.9150)		4										
4A	103320	LOCKWASHER, 5/16 (12.9200)									2			
4A	103321	LOCKWASHER, 3/8 (12.9200) # FIG. 108 OF 5.0000. * OBSOLETE.	4	4	2	1								
4A	117049	NUT, 3/8 -24 HEX. (12.9120)		4	2	1								
		2.3310 - FILTER ASSY., FUEL SEE ASSEMBLY BREAKDOWN PAGE 81.												
4A,#	5575565	FILTER ASSY. (T-64)	1	1										
4A,*	5574533	@ FILTER ASSY. (8) (T-65)			1	1		1	1	1	1	1	1	1
2B	6438840	CARTRIDGE, FUEL FILTER (SPIN-ON)			1	1	1	1	1	1	1	1	1	1
	103647	DRAINCOCK, 1/4 (12.9510)	1											
2B	5148171	COVER, FUEL FILTER (SPIN-ON)			1	1	1	1	1	1	1	1	1	1
	6437952	DECAL	1	1										
	5574516	@ DECAL			1	1		1	1	1	1	1	1	1
	639604	DECAL, FUEL FILTER (SPIN-ON)			1	1	1	1	1	1	1	1	1	1
	3292558	SPACER (5.4600)			4									
4A	446597	BOLT, 5/16 -18X6 1/2 (12.9001)			4									
4A	186619	BOLT, 3/8 -16X1 1/8 (12.9001)			2		2		2		2		2	2
4A	186679	BOLT, 3/8 -16X1 1/4 (12.9001)	4									2		
4A	181370	BOLT, 3/8 -24X1 1/4 (12.9001)				2								
4A	103341	WASHER, 3/8 FLAT (12.9200)	4				2							
4A	103321	LOCKWASHER, 3/8 (12.9200)	4		2	2	2		2		2	2	2	2
4A	102635	NUT, 3/8 -16 HEX. (12.9120)	4									2		
4A	117049	NUT, 3/8 -24 HEX. (12.9120) # FIG. 108 OF 5.0000. * FIG. 58 OF 4.0000. @ THRU 6VA-67342, 8VA-202807, 12VA-30149.				2								
	5121182	PLUG, 1/4" PIPE (12.9550)					1							
		2.3503 - STRAP, FUEL FILTER MOUNTING												
#	5127156	STRAP (2.3165)	2											
	132430	SCREW, 3/8 -16X2 1/2 FIL. HD. (12.9010)	2											

2.4000 FUEL MANIFOLD AND/OR CONNECTIONS

..FIG....	PART NUMBER..	.........NAME AND DESCRIPTION.........	5 5	...............TYPES...................
	2.4020 -	PIPE, FUEL		
		QUANTITIES SHOWN ARE PER CYLINDER.		
1A,B	5111527	PIPE ASSY. (LONG)	1	
1A,B	5111526	PIPE ASSY. (SHORT)	1	
	2.4030 -	CONNECTOR, FUEL PIPE		
1A,B	5117369	CONNECTOR	2	
	2.4050 -	WASHER, FUEL PIPE CONNECTION		
1A,B	5125108	WASHER	2	

2.5000A FUEL LINES

FIG	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
2.5010 -		TUBE, FUEL SUPPLY TO STRAINER FLEXIBLE												
		FOR TYPE 1217 USE TYPE 1213.												
	5199577	HOSE, BULK #10X25 FT. (21 L.)				1								1
	5199581	FITTING, HOSE 7/8 -18 INV. FL . . . STGHT.				2								2
	442343	ELBOW, 5/8 INV. FL. TUBE-90 DEG. . . (12.9480)				1								1
	442325	CONNECTOR, 5/8 INV. FL. TUBE . . . . (12.9460)				1								1
2.5020 -		CLIP, FUEL SUPPLY TO FUEL STRAINER TUBE												
	5146788	CLIP, HOSE 5/8 (2.5070)				2								
2.5050 -		TUBE, FUEL STRAINER TO FUEL PUMP												
	5199576	HOSE, BULK #8X25 FT. (16 L.)												1
	5199576	HOSE, BULK #8X25 FT. (17 L.)						1						
	5199576	HOSE, BULK #8X25 FT. (23 L.)			1									
	5199576	HOSE, BULK #8X25 FT. (29 L.)				1								
	5199576	HOSE, BULK #8X25 FT. (31 L.)											1	
	5199576	HOSE, BULK #8X25 FT. (33 L.)					1			1		1		
	5199576	HOSE, BULK #10X25 FT. (48 L.)							1					
	5199580	FITTING, HOSE 3/4 -18 INV. FL . . . STGHT.			2	1	2	1		2		2	2	1
	5199589	FITTING, HOSE 3/4 -18 INV. FL. 90 . . DEG.				1		1						
	5199594	FITTING, HOSE 3/4 -18 INV. FL. 45 . . DEG.												1
	5199581	FITTING, HOSE 7/8 -18 INV. FL . . . STGHT.							1					
	5199590	FITTING, HOSE 7/8 -18 INV. FL. 90 . . DEG.							1					
	9434182	ELBOW, 3/8 INV. FL. TUBE-90 DEG. . . (12.9480)							2					
	225828	ELBOW, 1/2 INV. FL. TUBE-90 DEG. . . (12.9480)			12	2	1	2		1		1		1
	143340	ELBOW, 1/2 INV. FL. TUBE-45 DEG. . . (12.9480)											1	
	5147206	TUBING, WRAP (14 L.) (7.7020)												2
	431538	CONNECTOR, 1/2 INV. FL. TUBE . . . . (12.9460)			1		1			1		1	1	1
	444002	ADAPTOR, 3/8" (4.6020)			1									
2.5060 -		TUBE, FUEL PUMP INLET												
	5147041	HOSE, FLEX. (36 L.)		1										
	225828	ELBOW, 1/2 INV. FL. TUBE 90 DEG. . . (12.9480)		1										

2.5000A FUEL LINES

2.5120 - CLIP, FUEL PUMP TO FILTER TUBE (CONT'D)

FIG	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
	179838	BOLT, 3/8 -16X7/8 (12.9001)							2					
	179839	BOLT, 3/8 -16X1 (12.9001)							2					
	5159347	SPACER, 13/32 X3/4 X1/2 (7.1581)							2					
	103341	WASHER, 3/8 FLAT (12.9190)							4					
	103321	LOCKWASHER, 3/8 (12.9200)							4					
	102635	NUT, 3/8 -16 (12.9120)							4					

2.5149 - TUBE, FILTER TO CYLINDER HEAD

FIG	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
4A	5147043	* HOSE, FLEX. (#6X11.5 L.)		1										
4A	5147044	* HOSE, FLEX. (#6X29 L.)		1										
4A	5199575	HOSE, BULK #6X25 FT. (8.5 L.)			1		1	1						
4A	5199575	HOSE, BULK #6X25 FT. (10 L.)								1				
4A	5199575	HOSE, BULK #6X25 FT. (11 L.)												1
4A	5199575	HOSE, BULK #6X25 FT. (12.5 L.)										1	1	
4A	5199575	HOSE, BULK #6X25 FT. (17 L.)				1								
4A	5199575	HOSE, BULK #6X25 FT. (26 L.)			1		1	1						1
4A	5199575	HOSE, BULK #6X25 FT. (27 L.)								1				
4A	5199575	HOSE, BULK #6X25 FT. (30.22)							1			1	1	
4A	5199575	HOSE, BULK #6X25 FT. (33 L.)				1								
4A	5199575	HOSE, BULK #6X25 FT. (45 L.)							1					
4A	5199593	FITTING, HOSE 5/8 -18 INV. FL. 45 DEG.			1		1	1	1	1				
4A	5199579	FITTING, HOSE 5/8 -18 INV. FL. STGHT.			2	2	2	2	3	2		2	2	2
4A	5199588	FITTING, HOSE 5/8 -18 INV. FL. 90 DEG.			1	2	1	1		1		2	2	2
	5142470	TUBING, WRAP (5 L.)		2		2	1	2	1	1				
	5142497	TUBING, WRAP (8 L.) (7.7020)		1		1	1	1				1	1	
	5101020	TUBING, WRAP (8 L.) (7.7020)												
4A	143338	ELBOW, 3/8 INV. FL. TUBE-45 DEG. (12.9480)		1	1		1	1		1			1	1
4A	193004	ELBOW, 3/8 INV. FL. TUBE-90 DEG. (12.9480)		3		2	3	3	1	3		1	1	
4A	9432249	ELBOW, 3/8 INV. FL. TUBE-90 DEG. (12.9480)							2					1
4A	442323	CONNECTOR, 3/8 INV. FL. TUBE (12.9460)				2			1					1
4A	9432267	CONNECTOR, 3/8 TUBE 3/8 PIPE (12.9000)										1	2	1
	444002	ADAPTOR, 3/8 (4.6020)											1	1
		* OBSOLETE												
	137423	ELBOW, 3/8" INV. FL. (12.9480)			3									

2.5163 - TUBE, FUEL SUPPLY CROSSOVER

FIG	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
	5147045	HOSE, FLEX (#6X19 L.)		1										
	5199575	HOSE, BULK #6X25 FT. (16 L.)					1							
	5199579	FITTING, HOSE 5/8 -18 INV. FL. STR.					2							

2.5000A FUEL LINES

FIG	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
		2.5060 - TUBE, FUEL PUMP INLET (CONT'D)												
	431538	CONNECTOR, 1/2 INV. FL. TUBE (12.9460)		1										
		2.5070 - CLIP, STRAINER TO FUEL PUMP TUBE												
	2362448	CLIP (1/2)		1	1	1	2			1		1	1	
	5146788	CLIP (5/8)				1			4					
		2.5100 - TUBE, PUMP TO FILTER												
4A	5147042	HOSE, FLEX. (12 L.)		1										
4A	5199575	HOSE, BULK #6X25 FT. (13 L.)			1		1							
4A	5199576	HOSE, BULK #8X25 FT. (21 L.)				1								
4A	5199575	HOSE, BULK #6X25 FT. (15 L.)						1		1				
4A	5199576	HOSE, BULK #8X25 FT. (51 L.)							1					
4A	5199576	HOSE, BULK #8X25 FT. (18 L.)										1	1	1
4A	5199580	FITTING, HOSE 3/4 -18 INV. FL. STGHT.				1			1			1	1	1
4A	5199589	FITTING, HOSE 3/4 -18 INV. FL. 90 DEG.				1			1					
4A	5199579	FITTING, HOSE 5/8 -18 INV. FL. STGHT.			1		1			1				
4A	5199588	FITTING, HOSE 5/8 -18 INV. FL. 90 DEG.			1		1			1				
4A	5199594	FITTING, HOSE 3/4 -18 INV. FL. 45 DEG.										1	1	1
4A	5199579	FITTING, HOSE 5/8 -18 INV. FL. STGHT.						2						
4A	193004	ELBOW, 3/8 INV. FL. TUBE-90 DEG. (12.9480)		1			1	2		1				
	9432249	ELBOW, 3/8 INV. FL. TUBE (12.9480)								1				
4A	225828	ELBOW, 1/2 INV. FL. TUBE-90 DEG. (12.9480)				1			2			1	2	2
4A	142340	ELBOW, 1/2 INV. FL. TUBE-45 DEG. (12.9480)										1		
4A	442323	CONNECTOR, 3/8 INV. FL. TUBE (12.9460)		1	1		1							
4A	431538	CONNECTOR, 1/2 INV. FL. TUBE (12.9460)				1								
	137423	ELBOW, 3/8" INV. FL. (12.9480)			1									
		2.5120 - CLIP, FUEL PUMP TO FILTER TUBE												
4A	2362448	CLIP (2.5070)				1			3					
4A	5143841	BRACKET, CLIP							2					
	186612	BOLT, 3/8 -16X1 1/4 (12.9001)							2					

2.5000A FUEL LINES

FIG.	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
			TYPES											
	2.5163 -	TUBE, FUEL SUPPLY CROSSOVER (CONT'D)												
	5142470	TUBING, WRAP (5 L.) (7.7020)		1		1								1
	193004	ELBOW, 3/8 INV. FL. TUBE-90 DEG. . . (12.9480)		1			1							
	116332	BUSHING, 3/8 X1/4 RED. (12.9570) . .		1			1							
	5104778	TEE, 1/4 X1/4 X5/8 (7.4694)		1			1							
	2.5180 -	CLIP, FILTER TO CYLINDER HEAD TUBE												
	2488022	CLIP, 3/8 (2.5100)		1	1	3	2	2	2	1		1	1	
	5126504	BRACKET, CLIP (4.1512)		1	1	1	1	1		1		1	1	
	5173022	BRACKET, CLIP (5.5379)				1								
	123435	BOLT, 1/4 -28X5/8 (12.9001)		1		1				1		1		
	179796	BOLT, 1/4 -20X7/8 (12.9001)			1		1	1		1		1	1	
	123450	BOLT, 1/4 -28X3/4 (12.9001)			1		1	1					1	
	179838	BOLT, 3/8 -16X7/8 (12.9001)				1								
	120392	WASHER, 1/4 FLAT (12.9190)		AR	3	AR	AR	AR		AR		AR	AR	
	103341	WASHER, 3/8 FLAT (12.9190)				1		2						
	103319	LOCKWASHER, 1/4 (12.9200)		2	2	2	2	2		1		1	1	
	103321	LOCKWASHER, 3/8 (12.9200)				1								
	102635	NUT, 3/8 -16 HEX. (12.9120)				1								
	121902	NUT, 1/4" - 28 (12.9120)			1									
	2.5205 -	TUBE, FUEL DRAIN CROSSOVER												
	5129437	* TUBE (DEV. L. 18.77)	1											
	5147045	HOSE, FLEX (19 L.)		1										
	5199575	HOSE, BULK #6X25 FT. (15 L.)												1
	5199575	HOSE, BULK #6X25 FT. (16 L.)			1	1		1		1		1	1	
	5199579	FITTING, HOSE 5/8 -18 INV. FL. . . . STGHT.			2	2		2		2		2	2	1
	5199588	FITTING, HOSE 5/8 -18 INV. FL. 90 . . DEG.												1
	9432245	ELBOW, 5/16 INV. FL. TUBE-90 DEG. . (12.9480)	1											
	193004	ELBOW, 3/8 INV. FL. TUBE-90 DEG. . . (12.9480)				1		1		1		1	1	1
	116332	BUSHING, 3/8 X1/4 RED. (12.9570) . .	1	1	1	1		1		1		1	1	1
	5127610	TEE, 1/4 X1/4 X5/8 (7.4694)		1	1	1		1		1		1	1	1
	444000	ADAPTOR, 1/4 -18 PIPE (12.9575) . . .						1		1			1	
	5145014	PLUG, 3/8 PIPE (12.9550)	1											
	5134840	CLIP (2.5220)	1											
	5133596	BRACKET, CLIP (2.5180)	1											
	181360	BOLT, 3/8 -24X3/4 (12.9001)	1											
	181374	BOLT, 3/8 -24X1 1/2 (12.9001) . . .	1											
	103341	WASHER, 3/8 FLAT (12.9190)	3											
	103321	LOCKWASHER, 3/8 (12.9200)	1											
	117049	NUT, 3/8 -24 HEX. (12.9120)	1											
	137423	ELBOW, 3/8" INV. FL (12.9480)			1									

FIG.	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
		2.5205 - TUBE, FUEL DRAIN CROSSOVER (CONT'D)												
		* NOT SERVICED CUSTOMER TO FABRICATE, REFER TO SECTION 12.8C008.												
		2.5212 - COOLER ASSY., FUEL												
10C	5136348	COOLER ASSY.								1	1			
	5181339	BRACKET (5.5070)								1				
	5108249	CLIP, 2 3/8 (5.2190)								1				
	179819	BOLT, 5/16 -18X1 1/8 (12.9001)								2				
	179858	BOLT, 7/16 -14X1 (12.9001)								1				
	106261	WASHER, 5/16 FLAT (12.9190)								1				
	106263	WASHER, 7/16 FLAT (12.9190)								1				
	103322	LOCKWASHER, 7/16 (12.9200)								2				
	123197	NUT, 5/16 -18 HEX. (12.9120)								1				
		2.5214 - TUBE, FUEL COOLER												
10A	5173450	HOSE, FLEX. (#2X2 1/2 L.) (5.3330)								2				
10C	5199575	HOSE, BULK #6X25 FT. (17 L.)									1			
10C	5199575	HOSE, BULK #6X25 FT. (21 L.)									1			
10C	5199575	HOSE, BULK #6X25 FT. (25 L.)								1				
10C	5199583	FITTING, HOSE 1/2 -20 INV. FL. STGHT.								1				
10C	5199597	FITTING, HOSE 1/2 -20 INV. FL. 45 DEG.									1			
10C	5199579	FITTING, HOSE 5/8 -18 INV. FL. STGHT.								1	3			
10C	5128927	ELBOW, 5/16 (.080 RESTRICTION)								1				
10C	193004	ELBOW, 3/8 INV. FL. TUBE 90 DEG. (12.9480)								1	2			
10C	9139809	CLAMP (3) (12.9660)								4				
10C	2488022	CLIP (2.5100)								1				
10C	442323	CONNECTOR, 3/8 INV. FL. TUBE (12.9460)									1			
		2.5215 - TUBE, FUEL DRAIN FLEXIBLE												
	5199575	HOSE, FLEX. #6X25 FT. (28.58 L.)	1											
	5147046	* HOSE, BULK #6X25 FT. (48 L.)		1										
	5199575	HOSE, BULK #6X25 FT. (12 L.)							1					
	5199575	HOSE, BULK #6X25 FT. (16 L.)							1					
	5199575	HOSE, BULK #6X25 FT. (25 L.)							1	1				
	5199575	HOSE, BULK #6X25 FT. (33 L.)			1									
	5199575	HOSE, BULK #6X25 FT. (36 L.)						1						

2.5000A FUEL LINES

FIG.	PART NUMBER	NAME AND DESCRIPTION	1210	1212	1213	1216	1219	1220	1222	1223	1224	1225	1227	1229
		2.5215 - TUBE, FUEL DRAIN FLEXIBLE (CONT'D)												
	5199575	HOSE, BULK #6X25 FT. (37 L.)				1							1	1
	5199575	HOSE, BULK #6X25 FT. (45 L.)					1					1		
	5199579	FITTING, HOSE 5/8 -18 INV. FL. STGHT.	1		1	1	1	1	6			1	1	1
	5199597	FITTING, HOSE 1/2 -20 INV. FL. 45 DEG.	1		1	1	1	1				1	1	1
	5199592	FITTING, HOSE 1/2 -20 INV. FL. 90 DEG.							2					
	5128927	ELBOW, 1/4 PIPE (.080 RESTRICTION)		1	1		1	1						
	5112892	ELBOW, 5/16 (.1065 RESTRICTION)	1											
	5116440	ELBOW, 5/16 (.070 RESTRICTION)							2					
	5177828	ELBOW, 5/16 -90 DEG. (.106 RESTRICTION)				1						1	1	1
	9432249	ELBOW, 3/8 INV. FL. TUBE-90 DEG. (12.9480)							1					
	193004	ELBOW, 3/8 INV. FL. TUBE-90 DEG. (12.9480)								1				
	137407	CONNECTOR, 3/8 INV. FL. TUBE (12.9460)	1	1		1	1	1	3	1		1	1	1
	5127610	TEE, 1/4 X1/4 X5/8 (7.4694) * OBSOLETE	1											
	442323	CONNECTOR, 3/8" INV. FL. TUBE (12.9460)			1									
		2.5220 - CLIP, FUEL DRAIN TUBE												
	2488022	CLIP (NEOPRENE)	2	3	2		5	3				2	2	2
	103341	WASHER, 1/4 FLAT (12.9120)					1							
		2.5250 - BLOCK, FUEL SYSTEM JUNCTION												
	5100246	BLOCK							1					
	5145010	PLUG, 1/4 PIPE (12.9550)							1					
	214054	BOLT, 5/16 -18X6 1/4 (12.9001)							1					
		2.5255 - SHIELDING, FLEXIBLE HOSE												
	5101020	STRAP, HOSE			3		4	4	7			4	6	

2.7COCA MECHANICAL GOVERNOR

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
		2.7030 - SPACER, GOVERNOR TO CYLINDER HEAD												
5A,B	5124333	COVER, GOVERNOR FUEL ROD	2	2	2	2	1	2	2	2	2	2	2	2
5A,B	5123812	GASKET (1.2060)	2	2	2	2	1	2	2	2	2	2	2	2
5A,B	5104627	HOSE (1 I.D.X13/16 L.)	2	2	2	2	2	2	2	2	2	2	2	2
5A,B	5104692	CLAMP, 1 3/8 HOSE (12.9600)	2	2	2	2	4	2	2	2	2	2	2	2
5A,B	5104152	BOLT, 1/4 -20X3/4 (12.9001)	4	4	4	4	2	4	4	4	4	4	4	4
5A,B	120392	WASHER, 1/4 FLAT (12.9190)	4	4	4	4		4	4	4	4	4	4	4
5A,B	103319	LOCKWASHER, 1/4 (12.9200)	4	4	4	4	2	4	4	4	4	4	4	4
		2.7045 - COVER ASSY., GOVERNOR (COMPLETE)												
		SEE ASSEMBLY BREAKDOWN PAGE A1.												
	5127729	COVER ASSY.	1		1			1				1	1	1
	5127730	COVER ASSY.		1										
	5140772	COVER ASSY.				1								
	5102647	COVER ASSY.					1		1	1	1			
	5101768	RETAINER, GOV. LEVER SPRING				1	1		1	1	1			
5A,B	453007	BOLT ASSY., 1/4 -20X1 HEX. HD (12.9001)				1	1		1	1	1			
5A,B	271468	BOLT, 1/4 -20X3/4 FIL. HD. (12.9010)	7	7	7			7				7	7	7
5A,B	9417926	BOLT, 1/4 -20X3/4 FIL. HD. (12.9010)				6	6		6	6	6			
5A,B	5183701	BOLT, 1/4 -20X5/8 FIL. HD. DRILLED (2.7812)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	103319	LOCKWASHER, 1/4 (12.9200)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
		2.7051 - GASKET, GOVERNOR COVER												
5A,B	5117899	GASKET	1	1	1	1	1	1	1	1	1	1	1	1
		2.7165 - LEVER, GOVERNOR COVER SHUTDOWN SHAFT												
5A	5183042	LEVER (2.9410)			1			1				1		
5A	5146369	SPACER	1	1	1			1						
5A	213546	BOLT, 1/4 -20X1 (12.9001)			1			1				1		
5A	120380	LOCKWASHER, 1/4 (12.9200)			1			1				1		
		2.7170 - LEVER, GOVERNOR COVER THROTTLE SHAFT												
	5158432	LEVER (2 1/4 BETWEEN HOLES)	1			1	1	1	1	1	1	1		
	5183671	LEVER (1 1/4 BETWEEN HOLES)		1										
	5100845	LEVER (2 1/16 BETWEEN HOLES)			1									
	213546	BOLT, 1/4 -20X1 (12.9001)	1	1	1	1	1	1	1	1	1	1		
	103319	LOCKWASHER, 1/4 (12.9200)	1	1	1	1	1	1	1	1	1	1		

2.7000A MECHANICAL GOVERNOR

2.7001 - GOVERNOR ASSY.

FOR TYPE 1062 USE TYPE 1295.
INCLUDES ITEMS IN 2.7045 THRU 2.7810
EXCEPT ITEMS IN 2.7165 AND 2.7170.

FIG	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
	5133790	* GOVERNOR ASSY. (LIMITING SPEED) (5101332)	1											
	5133784	GOVERNOR ASSY. (LIMITING SPEED)		1										
	5133599	GOVERNOR ASSY. (LIMITING SPEED)			1									
	5140775	* GOVERNOR ASSY. (VARIABLE SPEED) (5144131)				1								
	5102825	GOVERNOR ASSY. (VARIABLE SPEED)					1							
	5143729	* GOVERNOR ASSY. (LIMITING SPD.) (5101334)						1						
	5144127	GOVERNOR ASSY. (VARIABLE SPEED)							1		1			
	5144129	GOVERNOR ASSY. (VARIABLE SPEED)								1				
	5131833	* GOVERNOR ASSY. (LIMITING SPEED) (5133791)										1		
	5132616	* GOVERNOR ASSY. (LIMITING SPEED) (DUAL) (5133792)											1	
	5133792	GOVERNOR ASSY. (LIMITING SPEED) (DUAL)												1
5A,B	179827	@ BOLT, 5/16 -18X2 1/4 (12.9001)	7	7	7	7		7	7	7	7	7	7	7
5A,B	179827	BOLT, 5/16 -18X2 1/4 (12.9001)	8	8	8	8	8	8	8	8	8	8	8	8
5A,B	186271	BOLT, 5/16 -18X3 3/4 (12.9001)	1	1	1	1		1	1	1	1	1	1	1
5A,B	186272	BOLT, 5/16 -18X4 (12.9001)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	272545	BOLT, 5/16 -18X5 1/4 (12.9001)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	446202	WASHER, 5/16 FLAT COPPER (12.9190)	2	2	2	2		2	2	2	2	2	2	2
5A,B	5155596	WASHER, 5/16 FLAT (4.7120)	2	2	2		2	2	2	2	2			
5A,B	120393	@ WASHER, 11/32 FLAT (12.9190)	1	1	1	1		1	1	1	1	1	1	1
5A,B	103320	LOCKWASHER, 5/16 (12.9200)	8	8	8	8	8	8	8	8	6	8	8	8

* NOT SERVICED, COMPONENTS ARE AVAILABLE FOR COMPLETE REPLACEMENT USE GOVERNOR ASSEMBLY SHOWN.
@ THRU DEC. 1975
# EFF. JANUARY 1976

2.7002 - NAME PLATE, GOVERNOR

FIG	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
	5122166	NAME PLATE	1	1	1	1	1	1	1	1	1	1	1	1
	145369	SCREW, # 43/16 DRIVE RD. HD. (12.9067)	2	2	2	2	2	2	2	2	2	2	2	2

2.7010 - GASKET, GOVERNOR TO BLOWER

FIG	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
5A,B	5126459	GASKET (3.4190)	1	1	1	1	1	1	1	1	1	1	1	1

FIG	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
	2.7210 -	SPRING, GOVERNOR LEVER RETRACTING												
	5156530	SPRING (2.9405)				1								
	5108775	SPRING (2.9405)					1		1	1	1			
	2.7220 -	BRACKET, GOVERNOR LEVER RETRACTING SPRING												
	5134672	BRACKET				1								
	5173106	BRACKET (2.9405)							1					
	2.7235 -	HOUSING, GOVERNOR CONTROL												
		INCLUDES TUBE AND PIN.												
5A,B	5124426	HOUSING	1	1	1	1	1		1	1	1	1	1	1
	5101292	* HOUSING ASSY. (INCLUDES TUBES, PIN AND EXTERNAL STARTING AID SCREW)						1						
5A,B	5124332	TUBE (FUEL ROD COVER) (2.7230)	2	2	2	2	2	2	2	2	2	2	2	2
	5133798	TUBE (ROD CONNECTOR COVER)						1						
5A,B	5150942	PIN, 3/16 X7/16 DOWEL (COVER ALIGNING) (2.7230)	2	2	2	2	2	2	2	2	2	2	2	2
5A,B	116337	PLUG, 1 1/16 EXPANSION (12.9330)	1	1	1	1	1	1	1	1	1	1	1	1
	5101197	STARTING AID SCREW						1						
	5174286	LOCK NUT						1						
		* WHEN USING TO REPLACE 5133797 INCLUDE SHAFT ASSY. 5133795.												
	2.7250 -	SHAFT ASSY., GOV. OPERATING												
		INCLUDES ITEMS IN 2.7255, 2.7280, 2.7300 PLUS BEARING AND WASHER IN 2.7260.												
	5133795	SHAFT ASSY.	1	1	1	1	1		1	1	1	1	1	1
	5147174	@ SHAFT ASSY.						1						
		@ NOT SERVICED USE 5133795, (1) 5145007 AND (1) 5145008.												
	2.7255 -	SHAFT, GOVERNOR OPERATING												
5N	5133680	SHAFT	1	1	1	1	1	1	1	1	1	1	1	1
	2.7260 -	BEARING, GOVERNOR OPERATING SHAFT (UPPER)												
5A,B	9431896	BEARING	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5133686	SPACER	1	1	1	1	1	1	1	1	1	1	1	1
5B	9421917	SCREW & WASHER, #10-24X7/16	1	1	1	1	1	1	1	1	1	1	1	1

2.7000A MECHANICAL GOVERNOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	934	953	1054	1067	1075	1079	1087	1089	1090	1092
	2.7260	BEARING, GOVERNOR OPERATING SHAFT (UPPER) (CONT'D)												
5B	120391	(12.9025) WASHER, #10 FLAT (12.9120)	1	1	1	1	1	1	1	1	1	1	1	1
	2.7270	BEARING, GOVERNOR OPERATING SHAFT (LOWER)												
5A,B	954987	BEARING	1	1	1	1	1	1	1	1	1	1	1	1
	2.7280	LEVER, GOVERNOR OPERATING SHAFT												
5A,B	5132747	LEVER	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5132962	SCREW (GAP ADJUSTING)	1	1	1	1	1		1	1	1	1	1	1
	5145007	SCREW (GAP ADJUSTING)						1						
	5145008	SCREW (GAP ADJUSTING STOP)						1						
5A,B	114492	NUT, 1/4 -28 HEX. (12.9120)	1	1	1	1	1		1	1	1	1	1	1
	2.7290	FORK, GOVERNOR OPERATING SHAFT												
5A,B	5138335	FORK	1	1	1	1	1	1	1	1	1			1
5A,B	5185605	FORK										1	1	
	2.7300	PIN, GOVERNOR OPERATING SHAFT LEVER												
5A,B	5150943	PIN	1	1	1	1	1	1	1	1	1	1	1	1
	2.7310	LEVER ASSY., GOVERNOR DIFFERENTIAL												
5A,B	5150394	LEVER ASSY. (INCLUDES PIN IN 2.7315)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	142583	RETAINER, 13/64 SPRING (12.9640)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5150941	WASHER	1	1	1	1	1	1	1	1	1	1	1	1
	2.7312	LINK, GOVERNOR OPERATING LEVER CONNECTING												
5A,B	5117210	LINK	1		1	1	1		1	1	1	1	1	1
	5101236	LINK, THROTTLE YIELD (2.7170)		2										
	5124274	# LINK ASSY. (2.7170)		1				1						
	5124273	SPRING, THROTTLE YIELD LINK (2.7170)		2				2						
	5102559	PIN, THROTTLE YIELD LINK (2.7170)		1				1						
	455921	PIN, 1/8 X1 1/2 SLOTTED (12.9275)	1					1						
	5124270	HOOK, THROTTLE YIELD LINK (2.7170)		2				2						
5A,B	142583	RETAINER, 13/16 SPRING (12.9640)	1	1	1	1	1	1	1	1	1	1	1	1

2.7000A MECHANICAL GOVERNOR

2.7312 - LINK, GOVERNOR OPERATING LEVER CONNECTING (CONT'D)

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
5A,B	5150941	WASHER (2.7310) # INCLUDES LINK, SPRING, HOOK AND PIN IN 2.7312.	1	1	1	1	1	1	1	1	1	1	1	1

2.7315 - PIN, GOVERNOR DIFFERENTIAL LEVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
5A,B	5150894	PIN (25/32 L.)	1	1	1	1	1	1	1	1	1	1	1	1

2.7317 - LEVER ASSY., GOVERNOR CONTROL LINK OPERATING

INCLUDES BEARINGS.

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
5A,B	5127373	LEVER ASSY.	1	1	1	1	1		1	1	1	1	1	1
5A,B	5132871	LEVER ASSY.						1						
5A,B	447196	BEARING (2.7440)	2	2	2	2	2	2	2	2	2	2	2	2
5A,B	5143866	PIN (.375 DIA.X2 L.)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5127375	PIN (.309 DIA.X3.12 L.)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5117693	PIN (5/16 X1 L.)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5122263	CLIP, GOVERNOR CONTROL SHAFT LOCK	1	1	1	1						1	1	
5A,B	5143865	CLIP, GOVERNOR CONTROL SHAFT LOCK					1	1	1	1	1			1
5A,B	9421917	SCREW & WASHER, #10-24X7/16 (12.9025)	1	1	1	1	1	1	1	1	1	1	1	1
	5150885	WASHER (2.7430)	AR	AR	AR	AR	2	AR	AR	AR	AR	AR	AR	AR

2.7330 - CARRIER & WEIGHT ASSY., GOVERNOR

SEE ASSEMBLY BREAKDOWN PAGE B1.

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
	5122163	CARRIER & WEIGHT ASSY.	1	1	1							1		
	5122164	CARRIER & WEIGHT ASSY.				1	1		1	1	1			
	5143728	CARRIER & WEIGHT ASSY.						1						
	5132855	CARRIER & WEIGHT ASSY.											1	1

2.7380 - RISER, GOVERNOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
5A,B	5117193	RISER (1.062 L.)	1	1	1			1				1	1	1
5A,B	5147910	RISER (.865 L.)				1	1		1	1	1			

2.7000A MECHANICAL GOVERNOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1054	1067	1075	1079	1087	1089	1090	1092
	2.7460 -	BEARING, GOVERNOR WEIGHT RISER THRUST												
5A,B	9434171	BEARING (.354 W.)	1	1	1			1				1	1	1
5A,B	9433982	BEARING (.551 W.)				1	1		1	1	1			
	2.7470 -	BEARING, GOVERNOR WEIGHT SHAFT END												
5A,B	907674	BEARING (N.D. 3301LR1A)	1	1	1	1	1		1	1	1	1	1	1
5A,B	907681	BEARING (N.D. 3303FXR1A)						1						
5A,B	5150884	SCREW	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5150941	WASHER, 2V64 (2.7310)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5150897	LOCKWASHER	1	1	1	1	1	1	1	1	1	1	1	1
	2.7510 -	CAP, GOVERNOR WEIGHT HOUSING												
5A,B	5183268	CAP	1	1	1	1	1		1	1	1	1	1	1
5A,B	5140533	CAP						1						
	2.7515 -	GASKET, GOVERNOR WEIGHT HOUSING CAP												
5A,B	5165221	GASKET	1	1	1	1	1		1	1	1	1	1	1
5A,B	5134092	GASKET						1						
	2.7540 -	SPRING, GOVERNOR LOW SPEED												
5G	5122165	SPRING	1					1				1		
5G	5151604	SPRING		1	1									
5G	5183704	SPRING											1	1
	2.7550 -	SPRING, GOVERNOR HIGH SPEED												
5G	5136160	SPRING (2 PINK STRIPES)	1	1	1							1		
5G	5133651	SPRING (2 SILVER STRIPES)						1						
5D	5132859	SPRING (ALUMINUM STRIPE)											1	1
	2.7560 -	PLUNGER, GOVERNOR LOW SPEED SPRING												
5G	5182555	PLUNGER (5.32 L.)	1	1	1			1				1		
5D	5132854	PLUNGER (4.74 L.)											1	1

2.7000A MECHANICAL GOVERNOR

FIG	PART NUMBER	NAME AND DESCRIPTION	887	920	924	953	1064	1067	1075	1079	1087	1089	1090	1092
	2.7635 -	HOUSING, GOVERNOR HIGH SPEED SPRING ADJUSTING SCREW												
5G	5182559	HOUSING (3 7/32 L.)	1	1	1			1				1		
5D	5132858	HOUSING (4.08 L.)											1	1
5G	445520	BOLT, 5/16 -18X3 1/2 DRILLED HD. (12.9001)	2	2	2			2				2		
	5155596	WASHER, 5/16 FLAT COPPER (12.9190)	2	2	2			2				2		
	2.7650 -	GASKET, GOVERNOR HIGH SPEED SPRING COVER												
5G	5152944	GASKET	1	1	1			1				1	2	2
	2.7655 -	SCREW, GOVERNOR HIGH SPEED CONTROL												
5D	9414499	SCREW, 5/16 -24X1 1/2 HEX. SOCKET SET (12.9076)											1	1
5D	5133008	SHIM (.010)											AR	AR
5D	5133009	SHIM (.100)											AR	AR
	5155596	WASHER, 5/16 FLAT COPPER (12.9190)											1	1
	214279	NUT, 5/16 -24 SELF LOCKING (12.9120)											1	1
	2.7680 -	HOUSING ASSY., GOVERNOR VARIABLE SPEED SPRING SEE ASSEMBLY BREAKDOWN PAGE C1.												
	5139262	HOUSING ASSY.				1	1							
	5139662	HOUSING ASSY.							1		1			
	5144009	HOUSING ASSY.								1				
5F	445520	BOLT, 5/16 -18X3 1/2 (12.9001)				2	2		2	2	2			
5F	103320	LOCKWASHER, 5/16 (12.9200)				2	2		2	2	2			
	2.7700 -	GASKET, GOVERNOR VARIABLE SPEED SPRING HOUSING												
5F	5152944	GASKET (2.7650)				1	1		1	1	1			
	2.7760 -	SPRING, GOVERNOR VARIABLE SPEED												
5F	5122270	SPRING				1	1		1	1	1			
	2.7770 -	PLUNGER, GOVERNOR VARIABLE SPEED SPRING												
5F	5117932	PLUNGER (2.7560)				1	1		1	1	1			

FIG.	PART NUMBER	NAME AND DESCRIPTION	887	920	934	953	1054	1067	1075	1079	1087	1089	1090	1092
	2.7780 -	GUIDE, GOVERNOR VARIABLE SPEED SPRING PLUNGER												
5F	5152939	GUIDE				1	1		1	1	1			
	2.7790 -	RETAINER, GOVERNOR VARIABLE SPEED SPRING												
5F	5137276	RETAINER				1	1		1	1	1			
	2.7795 -	STOP, GOVERNOR VARIABLE SPEED SPRING												
5F	5171784	STOP (WITH STEP)				1	1		1	1	1			
5F	5174430	STOP (WITH GAP)				1	1		1	1	1			
	2.7800 -	SHIM, GOVERNOR VARIABLE SPEED SPRING												
5F	5136590	SHIM (.010)				AR	6		AR	AR	AR			
5F	5136591	SHIM (.078)				AR	3		AR	AR	AR			
	2.7810 -	SCREW ASSY., GOVERNOR BUFFER												
5A,B	5117952	SCREW ASSY. (WITH SPRING)	1	1	1	1	1	1	1	1	1	1	1	1
5A,B	5174286	NUT, 3/8 -24 LOCK (12.9140)	1	1	1	1	1	1	1	1	1	1	1	1
	5152929	SPRING	1	1	1	1	1	1	1	1	1	1	1	1
	2.7892 -	HOUSING ASSY., GOVERNOR CONTROL LINK INCLUDES ITEMS IN 2.7896 THRU 2.7902.												
	5133654	HOUSING ASSY.						1						
	5124333	COVER (2.7030)						2						
	5123812	GASKET (1.2060)						2						
	5124355	HOSE (1 I.D.X13/16 L.) (2.7030)						2						
	5133805	* HOSE (1 I.D.X.56 L.) (2.7030) (5118149)						1						
	451206	CLAMP, 1 HOSE (12.9660)						1						
	111612	CLAMP, 1 3/8 HOSE (12.9660)						2						
	454854	BOLT, 1/4 -20X3/4 (12.9001)						4						
	175827	BOLT, 5/16 -18X2 1/4 (12.9001)						6						
	186270	BOLT, 5/16 -18X3 1/2 (12.9001)						1						
	186272	BOLT, 5/16 -18X4 (12.9001)						1						
	186274	BOLT, 5/16 -18X5 (12.9001)						1						
	272545	BOLT, 5/16 -18X5 1/4 (12.9001)						1						
	120392	WASHER, 1/4 FLAT (12.9190)						4						

2.7000A MECHANICAL GOVERNOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	2.7045 -	COVER ASSY., GOVERNOR (COMPLETE)														
	5102547	COVER ASSY. (VARIABLE SPEED)	1													
	5117898	COVER ASSY. (LIMITING SPEED)		1												
	5125187	COVER ASSY. (LIMITING SPEED)				1										
	5127729	COVER ASSY. (LIMITING SPEED)			1											
	5127730	COVER ASSY. (LIMITING SPEED)					1									
	5135307	COVER ASSY. (LIMITING SPEED)						1								
	5140772	COVER ASSY. (VARIABLE SPEED)							1							
	5140771	COVER ASSY. (LIMITING SPEED)								1						
	2.7050 -	COVER ASSY., GOVERNOR (LESS SHAFT AND LEVERS)														
		INCLUDES PIN IN 2.7050, BEARINGS OR BUSHINGS IN 2.7100 AND BUSHING IN 2.7111.														
5A	5102621	COVER ASSY.	1													
5B	5117896	COVER ASSY.		1												
5B	5127259	COVER ASSY.			1											
5B	5125186	COVER ASSY.				1										
5B	5127263	COVER ASSY.					1									
	5135305	COVER ASSY.						1								
	5140773	COVER ASSY.							1							
	5140774	COVER ASSY.								1						
	141195	PIN, 1/4 X5/8 DOWEL (12.9290)		1												
	2.7093 -	SPRING, GOVERNOR THROTTLE SHAFT ARM RETURN														
	5132350	SPRING				1										
	2.7095 -	SHAFT ASSY., GOVERNOR THROTTLE														
		INCLUDES PIN IN 2.7095														
5A	5102471	SHAFT ASSY.	1													
5B	5117928	SHAFT ASSY.		1	1		1	1		1						
5B	5127748	SHAFT ASSY.				1										
	5134713	SHAFT ASSY.							1							
5B	5117750	SHAFT				1										
5A,B	113500	PIN, #1X7/8 TAPER (12.9820)		1	1	2	1	1	1	1						
	191758	FITTING, 1/8 LUBE (12.9540)				1										
	444687	PLUG, 1/8 PIPE (12.9550)			1		1	1		1						
	455297	PIN, 5/32" x 7/8" (12.9820)	1													
	2.7100 -	BEARING, GOVERNOR THROTTLE SHAFT														
5B	9415510	BEARING, NEEDLE (1/2 X3/8)				1										
5B	148402	BEARING, NEEDLE (1/2 X1/2)		2	2	1	2	2		2						
	5144065	BUSHING (1/2 X11/16 X1.00)							1							

2.7000A MECHANICAL GOVERNOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	2.7111 -	BUSHING, GOVERNOR SHUTDOWN SHAFT														
5B	5127267	BUSHING (3/8 I.D.X7/8 L.)			1	1		1		1						
	447196	BEARING, NEEDLE (2.7440)					2									
	2.7115 -	SHAFT ASSY., GOVERNOR SHUTDOWN														
5B	5143146	SHAFT			1	1	1	1		1						
	2.7117 -	SPRING, GOVERNOR SHUTDOWN SHAFT														
5B	5127213	SPRING					1	1								
5B	5131368	SPRING (RED STRIPE)			1	1				1						
	2.7140 -	WASHER, GOVERNOR THROTTLE SHAFT (PACKING)														
	5119673	WASHER				1										
	5126863	SPACER	1			1										
5A,B	5176557	SEAL RING (.487 I.D.X.103 THICK)	1	1	1	1	1	1	1	1						
	5197151	WASHER (33/64 I.D.) (SEAL RING BACK UP) (2.7140)		1	1	1	1	1	1	1						
	2.7145 -	WASHER, GOVERNOR SHUTDOWN SHAFT (PACKING)														
5B	5182977	SEAL RING (.362 I.D.X.103 THICK) (SHUTOFF)		1	1	1	1	1		1						
	5197150	WASHER (25/64 I.D.) (SEAL RING BACK UP)		1	1	1	1	1		1						
	2.7150 -	RETAINER, GOVERNOR THROTTLE SHAFT (PACKING)														
5A,B	5153060	RETAINER	1		1											
5A,B	5144177	RETAINER	1	2	2	2	2	2	2	2						
5A	5174429	RING, RETAINING	1	1	1		1	1	1	1						
5A,B	274270	RING (1/2)				1										
5A,B	274415	RING (1)				1										
	2.7155 -	RETAINER, GOVERNOR SHUTDOWN SHAFT (PACKING)														
5B	5151487	WASHER (2.7430)			2	2	2	2		2						
5B	5178581	RING, RETAINER (2.7430)			1	1	1	1		1						

FIG	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		2.7330 - CARRIER & WEIGHT ASSY., GOVERNOR														
	5108904	CARRIER & WEIGHT ASSY.			1											
	5113906	CARRIER & WEIGHT ASSY.				1										
	5122163	CARRIER & WEIGHT ASSY.		1												
	5122164	CARRIER & WEIGHT ASSY.	1													
	5133689	CARRIER & WEIGHT ASSY.					1									
	5133702	CARRIER & WEIGHT ASSY.						1								
	5132855	CARRIER & WEIGHT ASSY.							1							
	5143728	CARRIER & WEIGHT ASSY.								1						
		2.7350 - SHAFT & CARRIER ASSY., GOVERNOR WEIGHT														
		INCLUDES ITEMS IN 2.7360 AND 2.7370.														
	5174451	SHAFT & CARRIER ASSY.	1													
	5183624	SHAFT & CARRIER ASSY.		1	1	1			1							
	5133800	SHAFT & CARRIER ASSY.					1			1						
	5133814	SHAFT & CARRIER ASSY.						1								
		2.7360 - SHAFT, GOVERNOR WEIGHT CARRIER														
5A,B	5150923	SHAFT	1	1	1	1			1							
	5133801	SHAFT					1	1		1						
		2.7370 - CARRIER, GOVERNOR WEIGHT														
5A	5185606	CARRIER	1													
5B	5184336	CARRIER		1	1	1			1							
	5142474	CARRIER					1			1						
	5133704	* CARRIER * NOT SERVICED USE 1-5142475.						1								
		2.7390 - WEIGHT, GOVERNOR														
		A WEIGHT ASSY. INCLUDES BEARING IN 2.7440.														
5A	5147913	WEIGHT ASSY. (NARROW CAM)	2													
5B	5183723	WEIGHT ASSY. (HIGH SPEED)			2				2							
5A	5133812	* WEIGHT ASSY.						3								
	5111980	@ WEIGHT														
5B	5117737	WEIGHT ASSY. (HIGH SPEED)		2		2	3			3						
5B	5122162	* WEIGHT (LOW SPEED)		2			3									
5B	5183631	% WEIGHT (LOW SPEED)			2											
5B	5168606	= WEIGHT (LOW SPEED) (REQUIRES SET				2				3						

2.7000A MECHANICAL GOVERNOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		2.7390 - WEIGHT, GOVERNOR (CONT'D)														
		SCREW)														
5A	5133813	@ WEIGHT						3								
5B	5183779	+ WEIGHT, LOW SPEED (REQUIRES SET SCREW)							2							
5B	5147098	WEIGHT, LOW SPEED (PRESS-ON)		2			3									
5B	5147869	WEIGHT, LOW SPEED (PRESS-ON)			2											
5B	5147103	WEIGHT, LOW SPEED (PRESS-ON)				2				3						
5B	5147870	WEIGHT, LOW SPEED (PRESS-ON)							2							
5B	5144028	SCREW (2.7400)		2	2	2	3		2	3						
	5147866	BUSHING (SLIP FIT)		2	2	2	3		2	3						
		* NOT SERVICED USE 5147913 AND INCLUDE (1) 5147910 RISER. @ NOT SERVICED SEPARATELY, USE WEIGHT ASSY. & NOT SERVICED USE 5117738 PLUS 5147866. # NOT SERVICED USE (2) EACH 5147098, 5117738, 5147866, 5185153, 5151487 PLUS (4) 5178581. % NOT SERVICED USE (2) EACH 5147869, 5185153, 5150885, 5151487 AND (4) 5178581. = NOT SERVICED, USE (2) EACH 5147103, 5117738, 5147866, 5185153, 5151487 & (4) 5178581. + NOT SERVICED, USE (2) EACH 5147870, 5185153, 5150885, 5151487 AND (4) 5178581.														
		2.7430 - PIN, GOVERNOR WEIGHT														
5A	5185153	PIN (WITH PRESS ON WEIGHTS)		2	2		3		2	3						
5A	5185154	PIN (RING GROOVE)	2					3								
5B	5183632	PIN (REQUIRES SET SCREW)		2	2	2	3		2	3						
5A,B	5151487	WASHER (.032 THICK)	8	2	2	4	3	12	2	3						
5A,B	5150885	WASHER (.015 THICK)			2				2							
5A	5178581	RING, RETAINER	4	4	4		6	6	4	6						
		2.7440 - BEARING, GOVERNOR WEIGHT														
5A	447196	BEARING	4					6								
	451995	BEARING (HIGH SPEED)			2				2							
	5110665	BUSHING (PRESSED IN) (2.7100)		2						3						

2.7000A MECHANICAL GOVERNOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	COLUMN A
	2.7680 -	HOUSING ASSY., VARIABLE SPEED SPRING	
	5139262	HOUSING ASSY.	1
	5179124	HOUSING ASSY.	
	5139662	HOUSING ASSY.	
	5132980	* HOUSING ASSY. (5144009)	
	5144009	HOUSING ASSY.	
		* NOT SERVICED, COMPONENTS ARE AVAILABLE. FOR COMPLETE REPLACEMENT USE ASSY. SHOWN IN PARENTHESES WHICH INCORPORATES A NEW WIDER ROLLER BEARING.	
	2.7690 -	HOUSING, GOVERNOR VARIABLE SPEED SPRING	
	5145444	HOUSING	1
5F	5126060	@ HOUSING	
5F	5172557	# HOUSING	
	5145446	COVER	1
	5145445	GASKET	1
	9417926	BOLT ASSY., 1/4 -20X3/4 (12.9001)	1
	271468	SCREW ASSY., 1/4 -20X3/4 FIL. HD. (2.9010)	
	5126789	PLUG, .696 EXPANSION (12.9330)	1
5F	5145010	PLUG, 1/4 PIPE (12.9550)	
5F	142656	PLUG, 3/4 EXPANSION (12.9330)	
5F	5143564	BOLT (IDLE SPEED ADJUSTING SCREW)	1
5F	274856	NUT, 1/4 -20 HEX. (12.9120)	1
		@ NOT SERVICED, USE 5145444 HOUSING AND INCLUDE 1-5145446 COVER, 1-5145445 GASKET AND 1-271468 SCREW ASSY. # NOT SERVICED, USE 5126060 HOUSING AND INCLUDE 1-5176557 SEAL IN 2.7750 AND 1-5126789 PLUG IN 2.7690.	
	2.7712 -	BEARING, GOVERNOR VARIABLE SPEED SPRING LEVER SHAFT	
5F	148402	BEARING	2
	2.7720 -	SHAFT, GOVERNOR VARIABLE SPEED SPRING LEVER	
5F	5173964	SHAFT	1
5F	5101694	SHAFT	
5F	103904	KEY, 3/32 X1/2 WOODRUFF (12.9350)	2

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	COLUMN
	2.7730 -	LEVER, VARIABLE SPEED SPRING		
		A LEVER ASSY. INCLUDES LEVER, NOT SOLD SEPARATELY, AND ITEMS IN 2.7732		
5F	5179102	% LEVER ASSY. (ROLLER CONTACT)		
5F	5139469	LEVER ASSY. (ROLLER CONTACT)	1	
5F	5143665	WASHER (PACKING RETAINER)	1	
5F	223065	SCREW, 5/16 -24X1/4 SET (12.9076) .	1	
		% NOT SERVICED, USE 1-5139469 LEVER ASSY.		
	2.7732 -	BEARING, GOVERNOR VARIABLE SPEED SPRING LEVER		
	5139468	BEARING (ROLLER)	1	
	5179105	BEARING (ROLLER)		
	9425165	PIN	1	
	5179104	PIN		
	5185305	WASHER		
	2.7750 -	PACKING, GOVERNOR VARIABLE SPEED SPRING LEVER SHAFT		
5F	5176557	SEAL, O RING	1	
5F	5196633	SEAL (LIP TYPE)		

2.9000 INJECTOR CONTROLS

FIG.	PART NUMBER	NAME AND DESCRIPTION	95	TYPES 96	97	112	113	114	115	116	117	118	119	123
	2.9001 -	TUBE AND LEVER ASSY., INJECTOR CONTROL												
		INCLUDES ONE (1) FRONT BRACKET IN 2.9003, PIN IN 2.9007, LEVER AND PIN IN 2.9009 AND SPACER IN 2.9010.												
7A	5197426	TUBE ASSY. (LEFT BANK) (6V-71)	1				1			1				1
7A	5197425	TUBE ASSY. (RIGHT BANK) (6V-71)	1				1			1				1
7A	5196567	a TUBE ASSY. (RIGHT BANK) (5197427) (8V-71)		1				1			1			
7A	5196568	a TUBE ASSY. (LEFT BANK) (5197428) (8V-71)		1				1			1			
7A	5196570	a TUBE ASSY. (LEFT BANK) (5196758) (12V-71)			1				1			1		
7A	5196569	a TUBE ASSY. (RIGHT BANK) (5196757) (12V-71)			1				1			1		
7A	5196758	TUBE ASSY. (LEFT BANK) (12V-71)				1								
7A	5196757	TUBE ASSY. (RIGHT BANK) (12V-71)				1								
7A	5196567	a TUBE ASSY. (LEFT BANK FRONT AND RIGHT BANK REAR) (5197427) (16V-71)											2	
7A	5196568	a TUBE ASSY. (LEFT BANK REAR AND RIGHT BANK FRONT) (5197428) (16V-71)											2	
	2.9003 -	BRACKET, INJECTOR CONTROL TUBE	4 8											
7A	5130509	BRACKET		4	4	4	4	4	4	4	4	4	8	4
7A	9422203	BOLT, 1/4 -20X5/8 (12 POINT)		8	8	8	8	8	8	8	8	8	16	8
7A	120380	LOCKWASHER, 1/4 (12.9200)		AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
	2.9007 -	SHAFT, INJECTOR CONTROL TUBE END												
7A	5150259	SHAFT (1 1/16 L.)	2	2	2	2	2	2	2	2	2	2	4	2
	5150258	SHAFT (1.88" L.)	2											
	142487	PIN, 1/8" x 7/8" GROOVE (12.9270)	2											
	2.9009 -	LEVER, INJECTOR CONTROL TUBE												
7A	5150263	LEVER	2	2	2	2	2	2	2	2	2	2	4	2
7A	142486	PIN, 1/8 X3/4 GROOVE (12.9270)	2	2	2	2	2	2	2	2	2	2	4	2
	2.9010 -	SPACER, INJECTOR CONTROL TUBE LEVER												
7A	5150843	SPACER	2	2	2	2	2	2	2	2	2	2	4	2

2.9000 INJECTOR CONTROLS

2.9012 - SPRING, INJECTOR CONTROL TUBE

FIG	PART NUMBER	NAME AND DESCRIPTION	95	96	97	112	113	114	115	116	117	118	119	123
7A	5124142	SPRING (RETURN) (GREEN)	2	2	2	2	2	2	2	2	2	2	4	2

2.9014 - LEVER, INJECTOR CONTROL TUBE RACK

FIG	PART NUMBER	NAME AND DESCRIPTION	95	96	97	112	113	114	115	116	117	118	119	123
7A	5115322	LEVER	6	8	12	12	6	8	12	6	8	12	16	6
7A	5176228	SCREW, 1/4 -28X11/16	12	16	24	24	12	16	24	12	16	24	32	12

2.9022 - LINK, INJECTOR CONTROL TUBE TO GOVERNOR

FIG	PART NUMBER	NAME AND DESCRIPTION	95	96	97	112	113	114	115	116	117	118	119	123
7A	5117942	* LINK (LONG) (MECHANICAL GOVERNOR) (RIGHT BANK)	1	1	1	1								1
7A	5117191	LINK (SHORT) (MECHANICAL GOVERNOR) (LEFT BANK)	1	1	1	1								1
7A	5126102	@ LINK (LONG) (HYDRAULIC GOVERNOR)					1	1	1					
7A	5126101	@ LINK (SHORT) (HYDRAULIC GOVERNOR)					1	1	1					
7A	5127415	# LINK (LONG) (REAR LEFT BANK)					1	1	1	1	1	1	1	
7A	5127417	# LINK (SHORT) (REAR RIGHT BANK)					1	1	1	1	1	1	1	
7A	5127416	LINK (LONG) (FRONT LEFT BANK)											1	
7A	5127418	LINK (SHORT) (FRONT RIGHT BANK)											1	
	5150941	# WASHER (2.7310)					4	4	4	8	8	8	8	
	142583	# RETAINER (12.9640)					2	2	2	4	4	4	4	
7A	5147345	PIN	2	2	2	2	2	2	2	4	4	4	4	2
7A	103361	PIN, 1/16 X1/2 COTTER (12.9250)	2	2	2	2	2	2	2	4	4	4	4	2

* REAR BANK.
@ OPEN LINKAGE.
# ENCLOSED LINKAGE.

2.9030 - BRACKET, CYLINDER THROTTLE DELAY ROCKER SHAFT

FIG	PART NUMBER	NAME AND DESCRIPTION	95	96	97	112	113	114	115	116	117	118	119	123
	5132377	BRACKET (INCLUDES CYLINDER)												1
	5189790	PISTON (2.9862)												1
	5189788	LINK (2.9867)												1
	5110059	VALVE, CHECK (2.9862)												1
	5113369	LEVER (2.9867)												1
	5189789	PLUG (OIL SUPPLY) (2.9862)												1
	456540	PIN, SPRING (3/16 X5/8) (12.9300)												1
	5150265	PIN (1/4 X15/16) (2.9022)												1
	103361	PIN, 1/2 COTTER (12.9250)												2
	5150325	BOLT (1.8170)												2
	5180116	BOLT (U) (2.9867)												1
	103319	LOCKWASHER, 1/4 (12.9200)												2
	120375	NUT, 1/4 -20 HEX. (12.9120)												2

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover

2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls

3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler

4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System

5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter

6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections

7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid

8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines

9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission—Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car

10.0000	SHEET METAL
10.1000A	Engine Hood

11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base

12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits

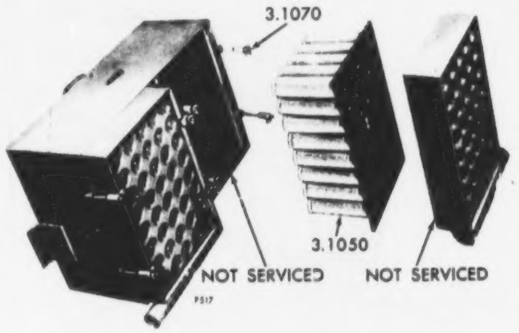

3.1070
3.1050
NOT SERVICED
NOT SERVICED
P517

FIG. 1C AIR CLEANER

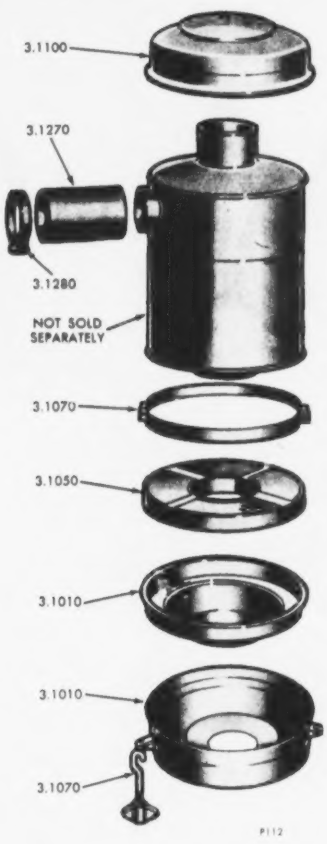

3.1100
3.1270
3.1280
NOT SOLD SEPARATELY
3.1070
3.1050
3.1010
3.1010
3.1070
P112

FIG. 1B AIR CLEANER (OIL BATH)

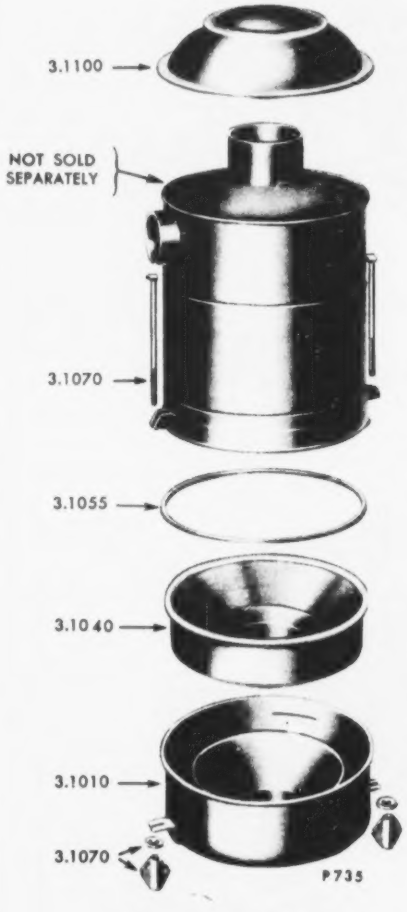

3.1100
NOT SOLD SEPARATELY
3.1070
3.1055
3.1040
3.1010
3.1070
P735

FIG. 1A AIR CLEANER (OIL BATH)

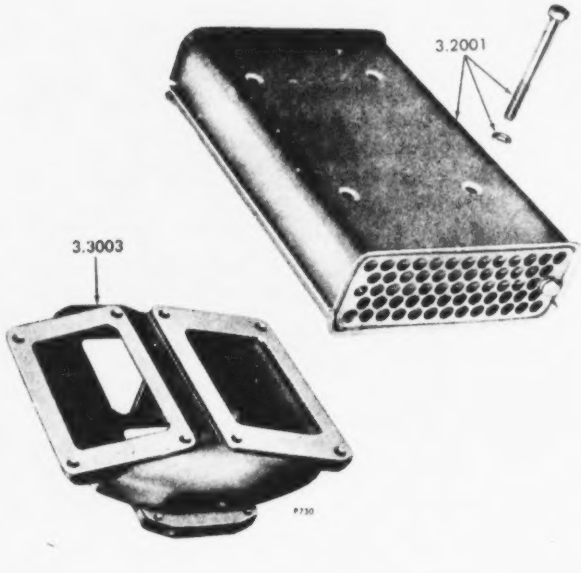

3.2001
3.3003
P730

FIG. 2A AIR SILENCER

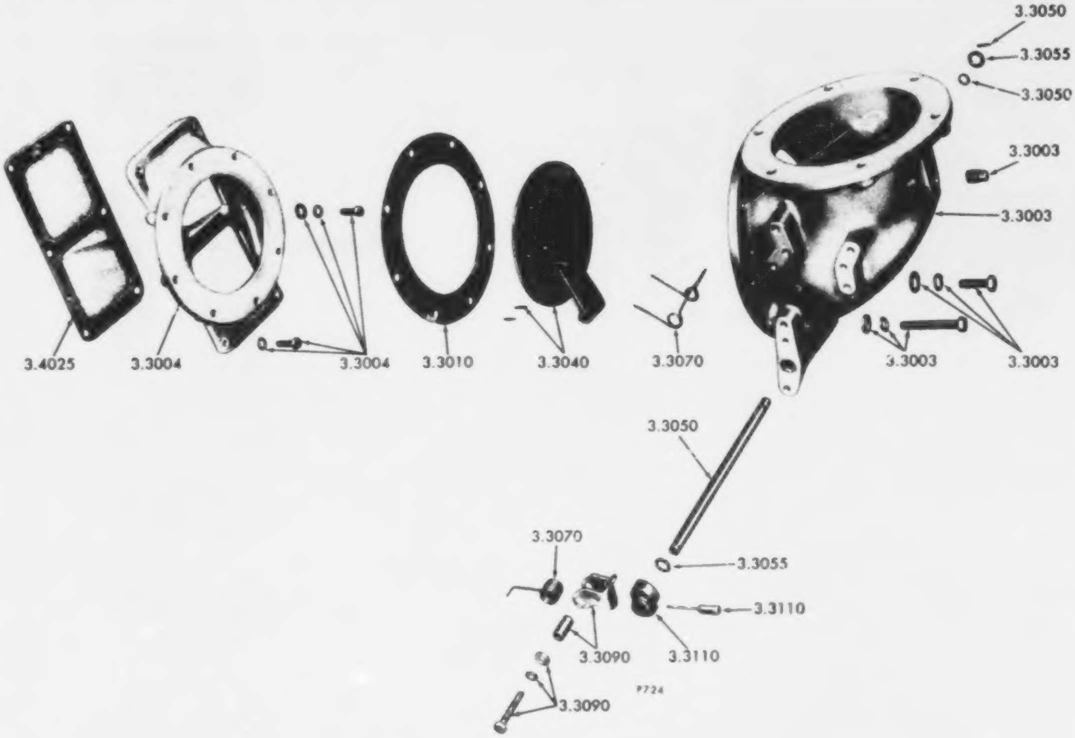

3.3050
3.3055
3.3050
3.3003
3.3003
3.4025
3.3004
3.3004
3.3010
3.3040
3.3070
3.3003
3.3003
3.3050
3.3070
3.3055
3.3110
3.3090
3.3110
P724
3.3090

FIG. 3A AIR INLET HOUSING

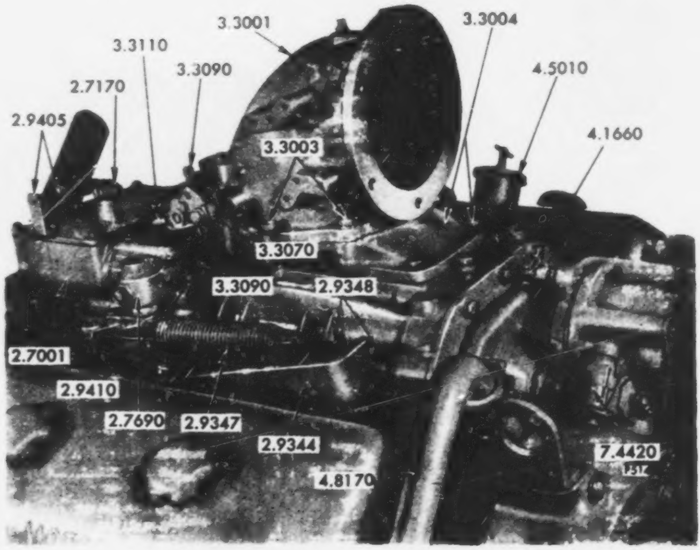

3.3001
3.3004
3.3110
3.3090
4.5010
2.7170
2.9405
4.1660
3.3003
3.3070
3.3090
2.9348
2.7001
2.9410
2.7690
2.9347
2.9344
4.8170
7.4420

FIG. 3B AIR INLET HOUSING

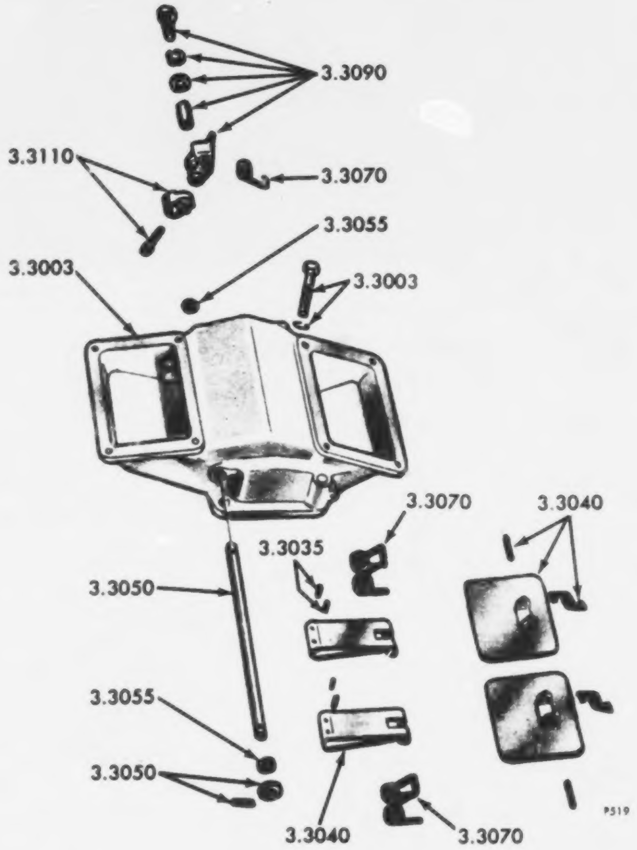

3.3090
3.3110
3.3070
3.3055
3.3003
3.3003
3.3070
3.3040
3.3035
3.3050
3.3055
3.3050
3.3040
3.3070
P519

FIG. 3C AIR INLET HOUSING (Marine Application)

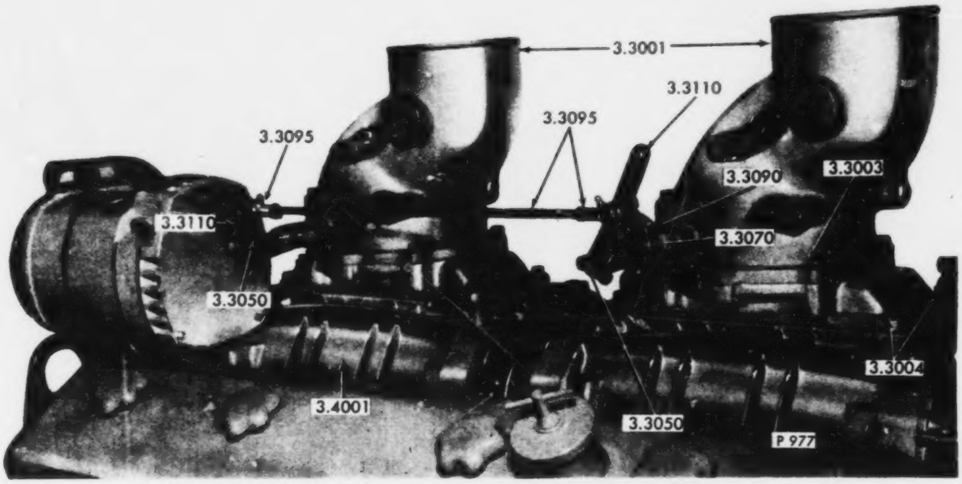

3.3001
3.3110
3.3095
3.3095
3.3090
3.3003
3.3110
3.3070
3.3050
3.3004
3.4001
3.3050
P 977

FIG. 3D UNITIZED SHUTDOWN

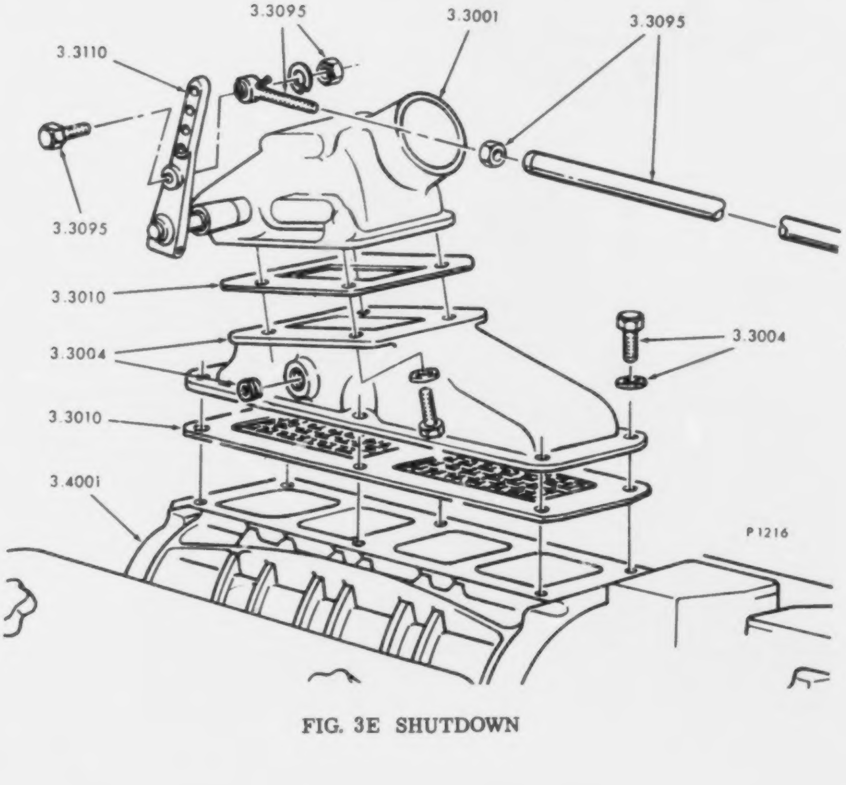
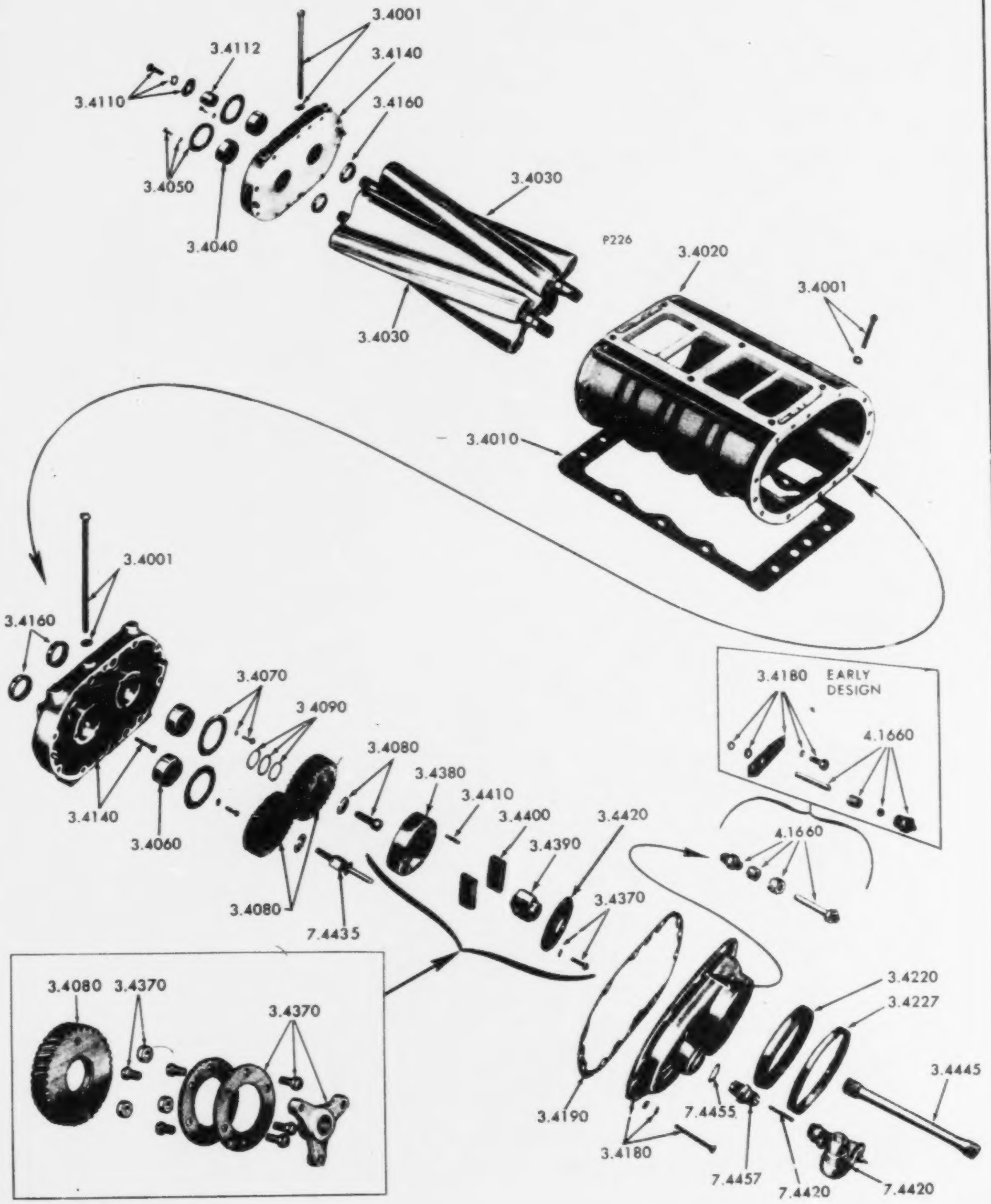

3.3095
3.3001
3.3095
3.3110
3.3095
3.3010
3.3004
3.3004
3.3010
3.4001
P1216

FIG. 3E SHUTDOWN


3.4001
3.4112
3.4140
3.4110
3.4160
3.4050
3.4030
3.4040
P226
3.4020
3.4001
3.4030
3.4010
3.4001
3.4160
3.4070
3.4180 EARLY DESIGN
3 4090
4.1660
3.4080
3.4380
3.4410
3.4140
3.4400
3.4060
4.1660
3.4420
3.4390
3.4080
3.4370
7.4435
3.4080
3.4370
3.4370
3.4220
3.4227
3.4445
3.4190
7.4455
3.4180
7.4457
7.4420
7.4420

BLOWER

Fig. 4A of 3.0000

Sept., 1973

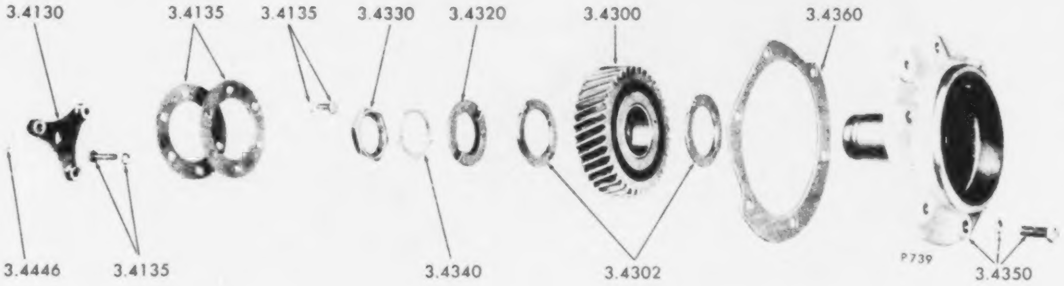

3.4130
3.4135
3.4135
3.4330
3.4320
3.4300
3.4360
3.4446
3.4135
3.4340
3.4302
P739
3.4350

FIG. 4B BLOWER DRIVE SUPPORT

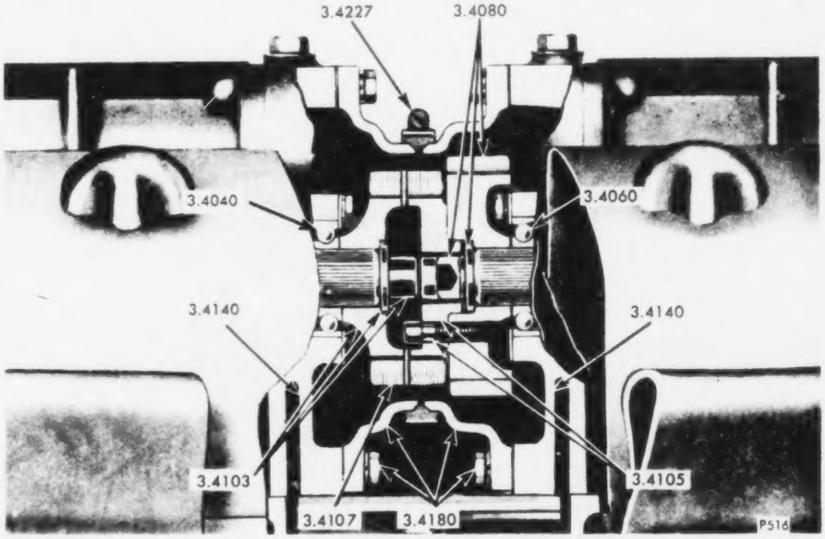

3.4227
3.4080
3.4040
3.4060
3.4140
3.4140
3.4103
3.4105
3.4107
3.4180
P516

FIG. 4C BLOWER COUPLING on 12V-71

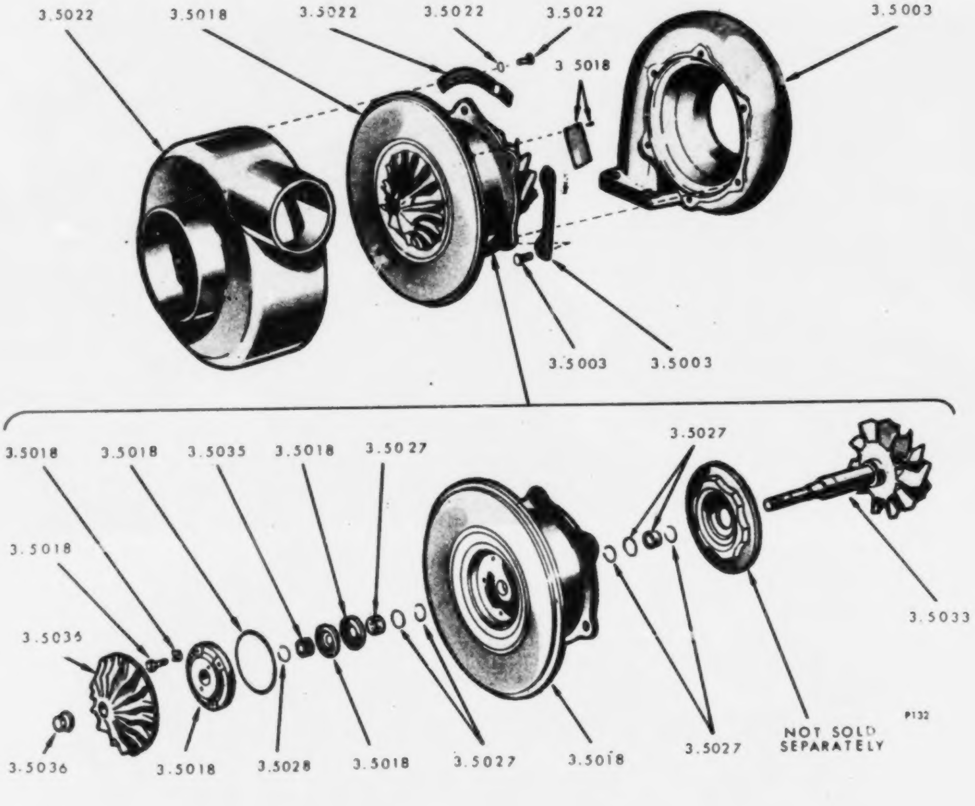

3.5022
3.5018
3.5022
3.5022
3.5022
3.5003
3 5018
3.5003
3.5003
3.5018
3.5018
3.5035
3.5018
3.5027
3.5027
3.5018
3.5035
3.5033
3.5036
3.5018
3.5028
3.5018
3.5027
3.5018
3.5027
NOT SOLD SEPARATELY
P132

FIG. 5A TURBOCHARGER ASSEMBLY

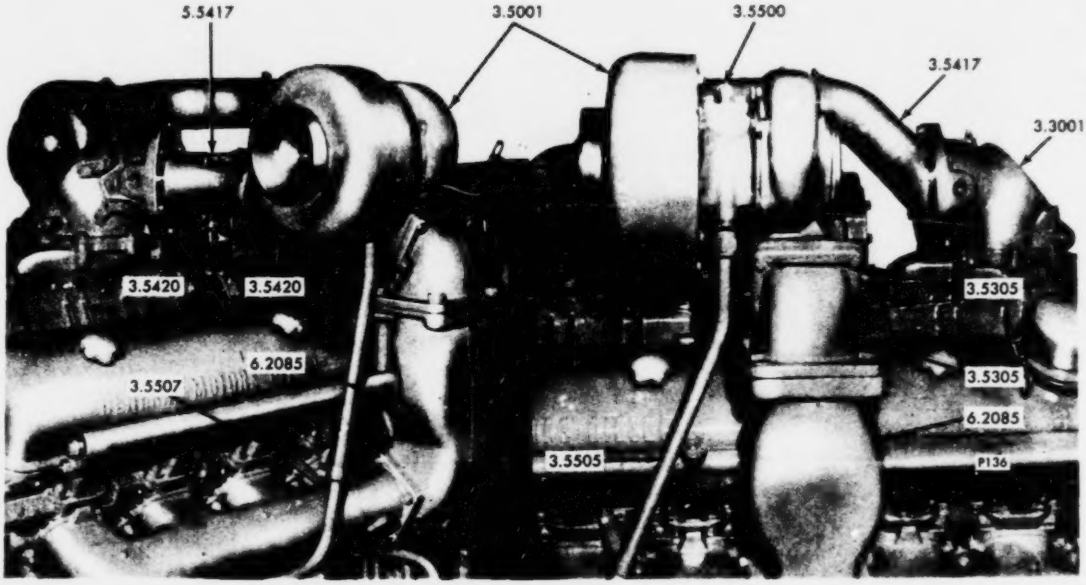

5.5417
3.5001
3.5500
3.5417
3.3001
3.5420
3.5420
6.2085
3.5507
3.5305
3.5305
6.2085
3.5505
P136

FIG. 5B TURBOCHARGER (Twin Installation)

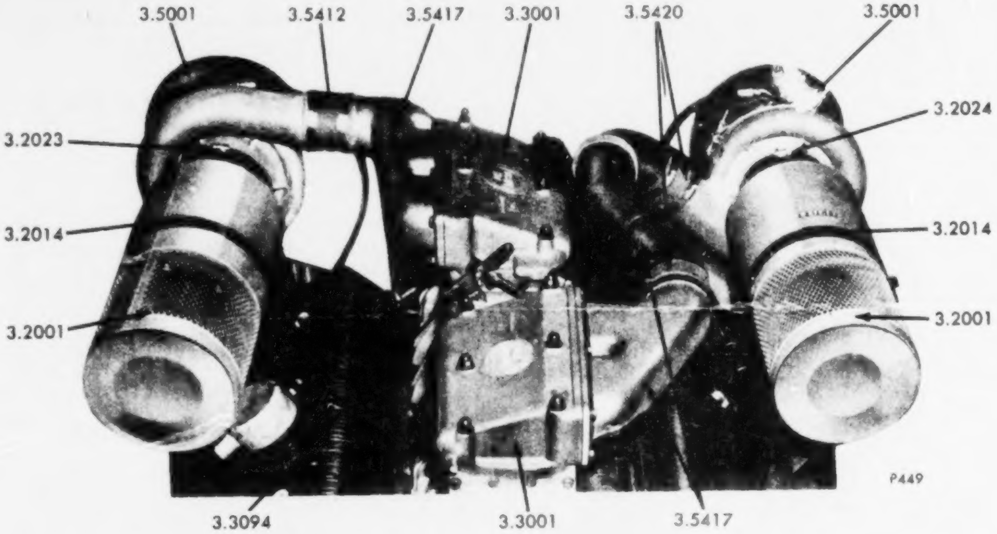

3.5001
3.5412
3.5417
3.3001
3.5420
3.5001
3.2023
3.2024
3.2014
3.2014
3.2001
3.2001
P449
3.3094
3.3001
3.5417

FIG. 5C TURBOCHARGER AIR INLET

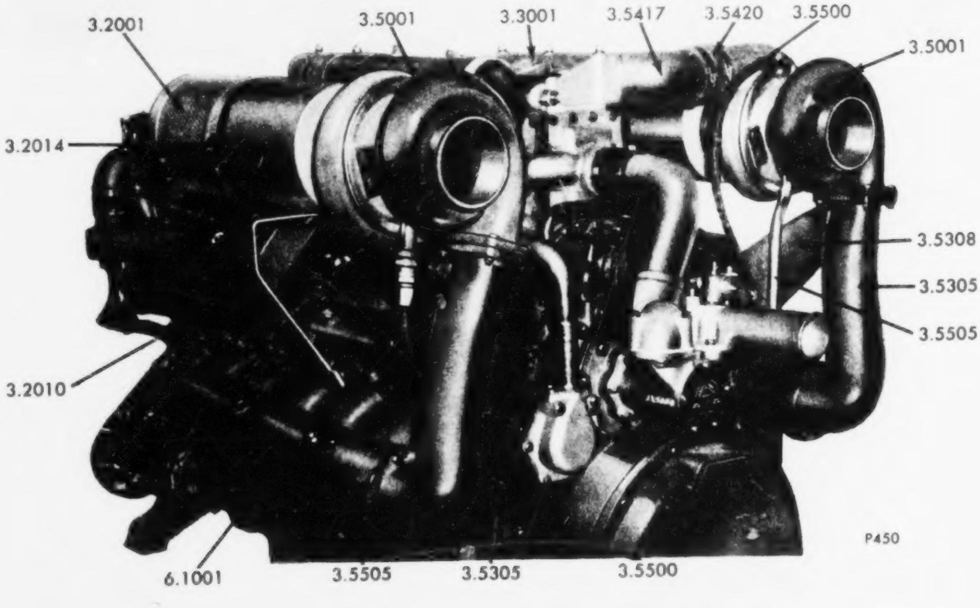

3.2001
3.5001
3.3001
3.5417
3.5420
3.5500
3.5001
3.2014
3.5308
3.5305
3.5505
3.2010
P450
6.1001
3.5505
3.5305
3.5500

FIG. 5D TURBOCHARGER INSTALLATION (Typical Marine)

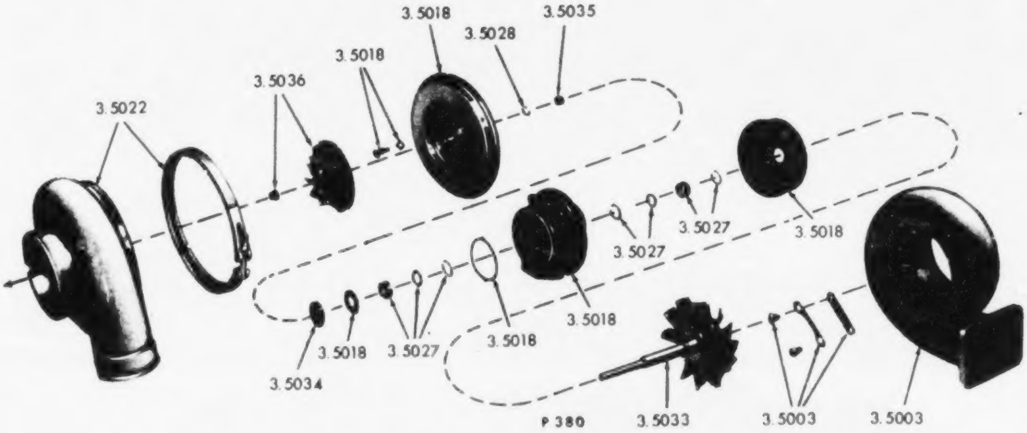

3.5018
3.5035
3.5028
3.5018
3.5036
3.5022
3.5027
3.5027
3.5018
3.5018
3.5018
3.5018
3.5027
3.5034
P 380
3.5033
3.5003
3.5003

FIG. 5E T18A40 TURBOCHARGER ASSY. (3.5001)

3.3000A AIR INLET HOUSING

3.3001 - HOUSING ASSY., AIR INLET

A HOUSING ASSEMBLY INCLUDES ITEMS IN 3.3CC3, 3.3040, 3.3050, 3.3055, 3.3070, 3.3090 AND 3.3110.

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES											
			240	2407	250	25[illegible]	2[illegible]	2661	265	2666	268	2669	270	2771
	NPN	HOUSING ASSY. (CUSTOMER FURNISHED)											1	
	5127752	HOUSING ASSY. (12V)		1										
	5179184	HOUSING ASSY. (6-8V)			1	1				1				
3B	5123644	HOUSING ASSY. (FRONT) (6-12-16V)					1	2						1
3B	5131764	HOUSING ASSY. (16V)							2					
	5127754	HOUSING ASSY. (6-8V)									1			
3B	5147666	HOUSING ASSY. (16V)										2		
3B	5133651	HOUSING ASSY. (REAR) (16V)												1

3.3003 - HOUSING, AIR INLET

FIG.	PART NUMBER	NAME AND DESCRIPTION	240	2407	250	25[illegible]	2[illegible]	2661	265	2666	268	2669	270	2771
	5108346	HOUSING	1											
3A	5122690	HOUSING (HORIZONTAL INLET)		1										
	5173876	HOUSING (WITH 3/4 TAPPED HOLE)			1	1				1				
3A	5123608	HOUSING (HORIZONTAL INLET)					1	2			1			1
	5131763	HOUSING (VERTICAL INLET)							2					1
	5125295	HOUSING (VERTICAL INLET)										2		
	9421747	PLUG, 5/8 CUP (12.9320)	1	1	1	1		1	1	1	1	1	1	1
	5125237	PLUG, 1/4 PIPE HEX. SOC. (1.2001)	1											
3A	5121182	PLUG, 1/4 PIPE (12.9550)		1				2	2		2			2
	5142549	PLUG, 3/4 PIPE (12.9550)			1	1				1				
3A	186622	BOLT, 3/8 -16X1 1/4 (12.9001)		4	4	4	4	8	10	4	4	8		8
3A	179850	BOLT, 3/8 -16X2 3/4 (12.9001)		2										
	190911	BOLT, 3/8 -16X2 7/8 (12.9001)	3											
3A	186283	BOLT, 3/8 -16X3 1/2 (12.9001)			2	2	2	4	4	2	2	4		4
	214265	BOLT, 3/8 -16X3 3/4 (12.9001)	3				6							
3A	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR	AR	AR	6	AR	AR	AR	AR	AR		AR
							6							

3.3004 - ADAPTOR, AIR INLET HOUSING

FIG.	PART NUMBER	NAME AND DESCRIPTION	240	2407	250	25[illegible]	2[illegible]	2661	265	2666	268	2669	270	2771
	5117572	* ADAPTOR		1										
3A,B	5144122	ADAPTOR			1			2						
3A,B	5123610	ADAPTOR				1			2	1		2	1	2
3A	5144122	ADAPTOR					1				1			
3A	186619	BOLT, 3/8 -16X1 1/8 (12.9001)		7	6	6		12	12	6	6	12	6	12
	186622	BOLT, 3/8 -16X1 1/4 (12.9001)		1										
	186612	BOLT, 3/8 -16X1 3/8 (12.9001)		4										
	103341	WASHER, 3/8 FLAT (12.9190)		AR	AR	AR	6	AR	AR	AR	AR	AR	AR	AR
3A	103321	LOCKWASHER, 3/8 (12.9200)		AR	AR	AR	6	AR	AR	AR	AR	AR	AR	AR
		* NOT SERVICED USE 1-5144121 ADAPTOR AND INCLUDE 1-445751 PLUG.												
	5145012	PLUG, 1/2" PIPE (12.9550)					1							

3.3000A AIR INLET HOUSING

FIG	PART NUMBER	NAME AND DESCRIPTION	240	247	250	251	258	261	265	266	268	269	270	271
		3.3010 - GASKET, AIR INLET HOUSING												
3A	5122692	GASKET		1										
3A	5123703	GASKET			1	1	1	2	2	1	1	2	1	2
		3.3040 - VALVE, AIR INLET HOUSING SHUTDOWN												
3A	5117315	VALVE		1										
3A	5123684	VALVE			1	1	1	2	2	1	1	2		2
3A	273436	PIN, 1/8 X11/16 ROLL (12.9300)		2	2	2	2	4	4	2	2	4		4
		3.3050 - SHAFT, AIR INLET HOUSING SHUTDOWN												
3A	5122296	SHAFT (7.54 L.)			1	1	1	2	2	1		2		2
3A	5126340	SHAFT (7.68 L.)									1			
3A	5126339	SHAFT (9.66 L.)		1										
3A	273436	PIN, 1/8 X11/16 ROLL (12.9300)		1	1	1	1	1	1	1	1	1		1
3A	453676	PIN, 1/8 X1 ROLL (12.9275)							1					1
	5198564	* BUSHING			2	2	2	4	4	2	2	4		4
3A	5146261	SPACER, 1 O.D.X.44 I.D.X.38							1					1
3A	103342	WASHER, 7/16"FLAT (12.9190)						AR						
3A	5156612	WASHER, 11/16 O.D.X.44 I.D.X.38 * REQUIRED TO REWORK SHAFT HOLES IN AIR INLET HOUSINGS.			AR	AR			AR	AR		AR		
		3.3055 - SEAL, AIR INLET HOUSING SHUTDOWN VALVE SHAFT												
3A	5135594	RING, SEAL		2	2	2	2	4	4	2	2	4		4
		3.3070 - SPRING, AIR INLET HOUSING SHUTDOWN VALVE TENSION												
3A,B	5111904	SPRING (VALVE)		1	1	1	1	2	2	1	1	2		2
3A	5114124	SPRING (LATCH)		1							1			
3A	5123743	SPRING (LATCH)			1	1	1	2	2	1		2		2
		3.3090 - LEVER, AIR INLET HOUSING SHUTDOWN VALVE												
3A,B	5112785	LATCH (WITH HORIZONTAL HOUSING)		1	1	1	1	2	2	1	1			1
3A,C	5114727	LATCH										2		1
3A	5113633	SPACER, 17/64 X7/8		1				2	2		1	2		2
	5143836	BUSHING, ECCENTRIC			1	1	1			1				
3A,B	180034	BOLT, 1/4 -20X1 1/2 (12.9001)		1				2	2		1	2		2
3A	179803	BOLT, 1/2 -20X1 3/4 (12.9001)			1	1	1			1				

3.3000A AIR INLET HOUSING

FIG.	PART NUMBER	NAME AND DESCRIPTION	240	247	250	251	258	261	265	266	268	269	270	271
	3.3090	- LEVER, AIR INLET HOUSING SHUTDOWN VALVE (CONT'D)												
3A	120392	WASHER, 1/4 FLAT (12.9190)		AR				AR	AR		AR	AR		AR
3A	120380	LOCKWASHER, 1/4 (12.9200)		AR	AR	AR		AR	AR	AR	AR	AR		AR
	3.3110	- LEVER ASSY., AIR INLET HOUSING SHUTDOWN RESET												
	5127443	LEVER		1							1			
3A,8	5114974	HANDLE ASSY.			1	1	1	2	2	1		2		2
3A,8	5122982	CAM		1	1	1	1	2	2	1	1	2		2
	273436	PIN, 1/8 X11/16 ROLL (12.9300)		1										
	453676	PIN, 1/8 X1 ROLL (12.9275)		1							1			
	103342	WASHER, 7/16 FLAT (12.9190)		AR							AR			
	3.3250	- WIRE, AIR INLET HOUSING SHUTDOWN CONTROL												
		CUSTOMER MUST DETERMINE PROPER WIRE AND ATTACHING PARTS REQUIRED FOR AN INSTALLATION.												
*	5146240	WIRE ASSY. (50 L.)					1	2				2	1	
*	5146239	WIRE ASSY. (90 L.) (2.9422)					1	1				2	1	
	110730	LOCKWASHER, 3/8 (12.9200)					1	1				2	1	
	124925	NUT, 3/8 -24 HEX. (12.9120) * FIG. 108 OF 8.0000.												
	3.3260	- PLATE, AIR INLET HOUSING SHUTDOWN CONTROL												
	5186687	PLATE, NAME (STOP)					1	1				2	1	
	132105	SCREW, #10-32X3/8 (12.9025)						1				2	1	
	3.3270	- CLIP, AIR INLET HOUSING SHUTDOWN CONTROL WIRE												
	3290565	CLIP (7.8320)					1	1				2	1	
	3796374	STOP (2.9426)					1	2				2	1	
	140855	SCREW, #8-32X5/16 SET (12.9076)					1	1				2	1	
	123298	BOLT, 1/4 -28X3/8 (12.9001)					1	1				2	1	
	120393	WASHER, 5/16 FLAT (12.9190)						1				2	1	
	120380	LOCKWASHER, 1/4 (12.9200)					1	AR				AR	AR	
	121902	NUT, 1/4 -28 HEX. (12.9120)					1	1				2	1	
	120394	WASHER, 3/8" (12.9190)					1							

3.4000 BLOWER

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 193	194	195	196	197	211	213	240
		3.4001 - BLOWER ASSY.								
		SEE ASSEMBLY BREAKDOWN PAGE A1 FOR COMPONENTS OF BASIC BLOWER ASSEMBLIES.								
	5103632	BLOWER ASSY. (BASIC) (8V)								1
	5121733	* BLOWER ASSY. (5125851 BASIC) (6V)						1		
	5148180	* BLOWER ASSY. (5144787 BASIC) (8-16V)	2	1	1	1	1		2	
	187491	BOLT, 3/8 -16X5 1/2 (12.9001)	12	6	6	6	6	4	12	4
	9411488	BOLT, 7/16 -14X8 1/4 (12.9001)	4	2	2	2	2	2	4	2
	5121905	WASHER, 15/32 I.D.X7/8 O.D.X5/32 L.	4	2	2	2	2	2	4	2
	5121814	WASHER, 3/8" W. .40" DIA. HOLE	12	6	6	6	6	4	12	4
		* COMPLETE BLOWER ASSEMBLY NOT SERVICED USE BASIC BLOWER ASSEMBLY SHOWN IN PARENTHESES.								
		3.4003 - GASKET KIT, BLOWER INSTALLATION								
		INCLUDES ITEMS IN 2.2007, 3.4010, 3.4025, 3.4220, 3.4227 AND 3.4360 PLUS GASKET IN 2.7030 AND (2) COPPER WASHERS IN 3.4350.								
	5156384	GASKET KIT						AR		AR
	5156385	GASKET KIT	AR	AR	AR	AR	AR		AR	
		3.4005 - BLOWER KIT, REPAIR								
		INCLUDES ITEMS IN 3.4040, 3.4060, 3.4090, LOCKWASHERS IN 3.4110, 3.4158, 3.4159, 3.4160 AND 3.4163. SEAL RING IN 3.4180 AND 3.4190.								
	5192796	BLOWER KIT (NON-TURBO)						AR		AR
	5198164	BLOWER KIT (TURBO)							AR	
	5199672	BLOWER KIT (LARGE BEARING) (TURBO AND PUMPER)	AR	AR	AR	AR	AR			
		3.4010 - GASKET, BLOWER								
4A	5147469	GASKET						1		1
4A	5141588	GASKET	2	1	1	1	1		2	
		3.4025 - SCREEN, BLOWER								
3A	5117591	SCREEN						1		
3A	5128033	SCREEN	2	1	1				1	
3A	5102062	SCREEN				1	1			
	5103616	SCREEN								1

3.4110 - DISC, BLOWER ROTOR FUEL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	194	195	196	197	211	213	240
4A	5154401	DISC	2	1	1	1	1	1	2	1
4A	182776	BOLT, 1/2 -20X1 1/4 (12.9001)	2	1	1	1	1	1	2	1
4A	5154398	LOCKWASHER, 1/2 (3.4080)	2	1	1	1	1	1	2	1
3A	5102062	SCREEN				1	1			

3.4112 - SPACER, BLOWER ROTOR FUEL PUMP COUPLING DISC

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	194	195	196	197	211	213	240
4A	5117778	* SPACER	1	1	1	1	1	1	1	1

* USE WITH MECHANICAL GOVERNOR AND HYDRAULIC GOVERNOR WITH CLOSED LINKAGE.

3.4130 - HUB, BLOWER ROTOR GEAR

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	194	195	196	197	211	213	240
4B	5122914	HUB	2	1		1	1		2	1
	5123081	@ HUB (WITH LUGS FOR ACCESSORY DRIVE)			AR			AR		

@ MARINE APPLICATION EFFECTIVE WITH 6VA-50622, 8VA-81197.

3.4135 - PLATE, BLOWER ROTOR GEAR HUB

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	194	195	196	197	211	213	240
4B	5122915	PLATE (SPRING)	4	2	2	2	2	2	4	2
4B	5122937	BOLT, 3/8 -24X1 5/16	12	6	6	6	6	6	12	6
4B	103321	LOCKWASHER, 3/8 (12.9200)	12	6	6	6	6	6	12	6

3.4180 - COVER, BLOWER HOUSING END PLATE

REFER TO ASSEMBLY BREAKDOWN PAGE 81 FOR COMPONENTS OF COVER KITS.

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	194	195	196	197	211	213	240
	5146521	COVER					1			
	5148179	COVER	2	1	1	1			2	
4A	5196760	# COVER KIT (3.4182)						1		
	5146490	FLANGE					1			
	5144477	CONNECTOR, 1/4 PIPE X 5/16 TUBE (12.9415)						1		1
	5144424	SEAL RING, 1/4 TUBE (12.9435)						1		1
4A	186643	BOLT, 5/16 -18X2 1/16 (12.9001)						8		12
	179828	BOLT, 5/16 -18X2 1/2 (12.9001)	20	10	10	10	10		20	
	5159714	WASHER						8		10
	103320	LOCKWASHER, 5/16 (12.9200)	20	10	10	10	10	10	20	12
	5144478	NUT, 1/4 TUBE (12.9445)						1		1

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES 193	194	195	196	197	2111	213	240
		3.4180 - COVER, BLOWER HOUSING END PLATE (CONT'D)								
		# THRU 12VA-131.								
		8VA-107424, 12VA-20733, 12VA-5165.								
		3.4190 - GASKET, BLOWER END PLATE HOUSING COVER								
	5126499	GASKET	2	1	1	1	1	2		1
		3.4220 - SEAL, BLOWER DRIVE COVER								
	5100901	SEAL	2	1	1	1	1	1	2	1
	5117717	TUBE (5/16 I.D.X4.20) (4.1660)	2	1	1	1	1	1	2	
	5144405	ADAPTOR (4.1660)						1		1
	114629	CONNECTOR, BALL SLEEVE (5/16 TUBE) (12.9410)	2	1	1	1	1	2	2	
	5146492	CONNECTOR, 1/4 PIPE (12.9415)	2	1	1	1	1		2	
	5144424	SEAL RING, 1/4 TUBE (12.9435)	2	1	1	1	1		2	
	114631	SLEEVE, BALL (5/16 TUBE) (12.9430)	2	1	1	1	1	1	2	
	114630	NUT, BALL SLEEVE (5/16 TUBE) (12.9440)	2	1	1	1	1	1	2	
	5144478	NUT, 1/4 TUBE (12.9445)	2	1	1	1	1		2	
		3.4227 - CLAMP, BLOWER DRIVE COVER PACKING								1
4	5120645	CLAMP	2	1	1	1	1	1	2	
		3.4300 - GEAR, BLOWER DRIVE								
		INCLUDES BUSHING IN 3.4355.								
48	5122918	GEAR ASSY. (L.H. HELIX) (38 TEETH)						1		1
48	5122920	GEAR ASSY. (L.H. HELIX) (40 TEETH)			1	1	1		1	
48	5109602	GEAR ASSY. (L.H. HELIX) (39 TEETH)	1	1						
48	5109601	GEAR ASSY. (R.H. HELIX) (39 TEETH)	1							
48	5122919	GEAR ASSY. (R.H. HELIX) (40 TEETH)							1	
		3.4302 - WASHER, BLOWER DRIVE GEAR THRUST								
48	5117700	BEARING, THRUST	4	2	2	2	2	2	4	2
		3.4320 - WASHER, BLOWER DRIVE GEAR HUB THRUST								
48	5117704	WASHER	2	1	1	1	1	1	2	1

3.4000 BLOWER

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES							
			193	194	195	196	197	211	213	240
	3.4330 -	NUT, BLOWER DRIVE GEAR HUB								
4B	5117727	NUT (1 7/16 -16)	2	1	1	1	1	1	2	1
	3.4340 -	LOCKWASHER, BLOWER DRIVE GEAR								
4B	5117720	LOCKWASHER (1 15/32)	2	1	1	1	1	1	2	1
	3.4350 -	SUPPORT, BLOWER DRIVE GEAR HUB								
		SUPPORT ASSY. INCLUDES SPRING PIN AND DOWEL PINS IN 3.4350.								
4B	5138836	SUPPORT ASSY.	2	1	1	1	1	1		1
4B	5117722	SUPPORT ASSY. (REAR)							1	
4B	5138836	SUPPORT ASSY. (FRONT)							1	
	274889	PIN, 1/8 X1/4 SPRING (12.9270)	2	1	1	1	1		2	1
	141126	PIN, 5/32 X1/4 DOWEL (12.9290)	4	1	1	1	1		4	
4B	181361	BOLT, 3/8 -24X7/8 (12.9001)	4	2	1	1	1	1	3	1
4B	181365	BOLT, 3/8 -24X1 1/8 (12.9001)			1	1	1	1	1	1
	186317	BOLT, 3/8 -24X5 (12.9001)							1	
4B	5152148	WASHER, 3/8 COPPER (2.4050)	4	2	2	2	2	2	4	2
	141147	PIN, 3/16" x 1/4" DOWEL (12.9290)								2
	3.4355 -	BEARING, BLOWER DRIVE GEAR HUB SUPPORT								
	5120501	BUSHING	4	2	2	2	2	2	4	2
	3.4360 -	GASKET, BLOWER DRIVE GEAR HUB SUPPORT								
4B	5148810	GASKET	2	1	1	1	1	1	2	1
	3.4370 -	COUPLING, BLOWER DRIVE								
		A COUPLING ASSY. INCLUDES ITEMS IN 3.4360 THRU 3.4410.								
	5103377	COUPLING ASSY.								1
	5150344	COUPLING ASSY.						1		
	5141473	COUPLING	2	1	1	1	1		2	
4B	5141474	PLATE	4	2	2	2	2		4	
	5173364	SPACER	6	3	3	3	3		6	
4A	5173362	BOLT, 5/16 -24X.75 (3.4135)	6	3	3	3	3		6	
4A	5173363	BOLT, 5/16 -24X1 (3.4135)	6	3	3	3	3		6	
4A	186645	BOLT, 5/16 -24X1 5/8 (12.9001)						6		6
4A	103340	WASHER, 5/16 (12.9120)	12	6	6	6	6		12	

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	194	195	196	197	211	213	240
		3.4370 - COUPLING, BLOWER DRIVE (CONT'D)								
4A	103320	LOCKWASHER, 5/16 (12.9200)	12	6	6	6	6	6	12	6
		3.4380 - SUPPORT, BLOWER DRIVE COUPLING								
4A	5150345	SUPPORT						1		1
		3.4390 - CAM, BLOWER DRIVE COUPLING								
4A	5150348	CAM						1		
	5103365	CAM								1
		3.4400 - SPRING, BLOWER DRIVE COUPLING								
4A	5196314	SPRING PACK						1		1
		3.4410 - SEAT, BLOWER DRIVE COUPLING SPRING								
4A	5150346	SEAT						4		4
		3.4420 - RETAINER, BLOWER DRIVE COUPLING								
4A	5150349	RETAINER						1		1

3.4000 BLOWER

3.4001 - BLOWER ASSY.

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5117836	BLOWER ASSY. (8-16V)	1													
	5124430	BLOWER ASSY. (6-12V)		1												
	5124431	BLOWER ASSY. (8-16V)			1											
BLOWER	5125851	BLOWER ASSY. (6-12V)				1										
	5147152	BLOWER ASSY. (8V)					1									
	5144787	BLOWER ASSY. (8-16V)						1								
	5103532	BLOWER ASSY. (6V)							1							

3.4020 - HOUSING, BLOWER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5117935	HOUSING	1					1								
	5117419	HOUSING		1		1			1							
	5139820	HOUSING			1		1									

3.4030 - ROTOR, BLOWER

A ROTOR ASSY. INCLUDES PLUGS IN 3.4030 AND SHAFT AND PIN IN 3.4035. A ROTOR SET INCLUDES RH AND LH ROTOR ASSY. AND MUST BE USED THRU 8VA-14964 AND 16VA-614.

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5134340	ROTOR ASSY. (RH HELIX)	1		1											
	5134341	ROTOR ASSY. (LH HELIX)	1		1											
	5117067	ROTOR ASSY. (RH HELIX)		1		1			1							
	5117072	ROTOR ASSY. (LH HELIX)		1		1			1							
	5144778	ROTOR ASSY. (RH HELIX)					1	1								
	5144779	ROTOR ASSY. (LH HELIX)					1	1								
	5198156	ROTOR SET	AR	AR	AR	AR	AR	AR								
	9428477	PLUG, CUP	12	12	12	12	12	12	12							

3.4035 - SHAFT, BLOWER ROTOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5117071	SHAFT	3	3	3	3	1	1	3							
	5150216	SHAFT					2	2								
	5150869	SHAFT ASSY. (INCL. PLUG)	1	1	1	1			1							
	5142412	SHAFT ASSY. (INCL. PLUG)					1									
	142522	PIN, 1/4 X1 3/4 GROOVE (12.9270)	4	4	4	4	4	4	4							

3.4037 - PLUG, BLOWER ROTOR SHAFT

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5150829	PLUG, 7/8 CUP (4.8001)	1	1	1	1	1	1	1							

3.4040 - BEARING, BLOWER ROTOR FRONT

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	7451054	BEARING	2	2	2	2			2							
	7451749	BEARING					2	2								

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3.4050 -		RETAINER, BLOWER ROTOR FRONT BEARING														
	5103526	RETAINER							4							
	5179017	RETAINER	2	2	2	2										
	5147147	RETAINER					2	2								
	5148794	BOLT, 1/4 -20X5/8 (3.4050)					6	6								
	443603	BOLT, 1/4 -20X3/4 (12.9001)	6	6	6	6			12							
	120380	LOCKWASHER, 1/4 (12.9200)	6	6	6	6			12							
3.4060 -		BEARING, BLOWER ROTOR REAR														
	954418	BEARING	2	2	2	2			2							
	907933	BEARING					2	2								
3.4070 -		RETAINER, BLOWER ROTOR REAR BEARING														
	5179017	RETAINER	2	2	2	2										
	5141605	RETAINER					2	2								
	5148794	BOLT, 1/4 -20X5/8 (3.4050)					6	6								
	443603	BOLT, 1/4 -20X3/4 (12.9001)	6	6	6	6										
	120380	LOCKWASHER, 1/4 (12.9200)	6	6	6	6										
3.4080 -		GEAR SET, BLOWER ROTOR														
	5196321	GEAR SET	1	1	1	1	1	1	1							
	5117082	SPACER, .53 X1.16 (3.4103)	2	2	2	2										
	5141468	SPACER					2	2								
	5146049	SPACER, .53 I.D.X1.16 O.D.X.34 THK. (3.4103)					2	2								
	5117081	BOLT, 1/2 -20X1 1/4	2	2	2	2										
	9409060	# BOLT, 1/2 -20X1 1/2 LK. (12.9001)					2	2								
	5147149	BOLT, 1/2 -20X1 1/2 (TACH. DRIVE) (7.4435)					1									
		# DEDUCT (1) 9409060 BOLT WHEN TACH. DRIVE IS USED.														
	5103364	BOLT, ½" – 20 x 1.10"							2							
3.4090 -		SHIM, BLOWER ROTOR GEAR														
	5150372	SHIM (.002)	AR	AR	AR	AR	AR	AR	AR							
	5153938	SHIM (.003)	AR	AR	AR	AR	AR	AR	AR							
	5150855	SHIM (.005)	AR	AR	AR	AR	AR	AR	AR							
	5150856	SHIM (.010)	AR	AR	AR	AR	AR	AR	AR							

3.4140 - PLATE, BLOWER HOUSING END

A PLATE ASSY. INCLUDES PIN, STRAINER, PLUG AND SLEEVE IN 3.4140 AND SEAL IN 3.4160.

3.4000 BLOWER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	3.4140	PLATE, BLOWER HOUSING END (Cont, D)							1							
									1							
	5103526	PLATE ASSY. (FRONT)							1							
	5103490	PLATE ASSY. (REAR)							1							
	5117458	* PLATE ASSY. (FRONT) (5144411)	1			1										
	5123468	@ PLATE ASSY. (REAR) (5144646)	1		1	1										
	5124295	@ PLATE ASSY. (REAR) (5144646)		1												
	5124294	& PLATE ASSY. (FRONT) (5144411)		1	1											
	5141538	% PLATE ASSY. (FRONT) (5147150)					1	1								
	5144785	& PLATE ASSY. (REAR) (5144784)						1								
	5141471	# PLATE ASSY. (REAR) (5146523)					1									
	5150542	PIN, DOWEL (2 LONG)	2	2	2	2	4	4	2							
	5157933	PIN, DOWEL (7/8 LONG)	2	2	2	2		2	2							
	5145009	PLUG, 1/8 PIPE (12.9550)	2	2	2	2	2	2	2							
	5109389	STRAINER, OIL PASSAGE	2	2	2	2	2	2	2							
	5127477	SLEEVE, BOLT GUIDE	2	2	2	2	2	2	2							
	117296	SCREW, 5/16 -18X1 1/2 FIL. HD. . . . (12.9010)	4	4	4	4			4							

* NOT SERVICED USE BASIC PLATE SHOWN IN PARENTHESES & INC. (2) 5110330 COLLARS, (2) 5150542 PINS, (1) 5109389 STRAINER & (1) 5127477 SLEEVE.

@ NOT SERVICED USE BASIC PLATE SHOWN IN PARENTHESES & INC. (1) 5144477 CONNECTOR, (1) 5144424 SEAL RING & (1) 5144478 NUT IN 3.4160.

& NOT SERVICED. USE BASIC PLATE SHOWN IN PARENTHESES.

% NOT SERVICED. USE BASIC PLATE SHOWN IN PARENTHESES AND INCLUDE 5147147 RETAINERS AND 2-113989 SCREWS.

NOT SERVICED. USE BASIC PLATE SHOWN IN PARENTHESES AND INCLUDE 2-179828 BOLTS, 1-5141609 BLOWER DRIVE SHAFT, 1-5146492 CONNECTOR, 1-5144424 SEAL RING AND 1-5144478 NUT.

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	3.4158 -	CARRIER, BLOWER HOUSING END PLATE SEAL RING														
	5100727	CARRIER (ON ROTOR SHAFTS)		4	4		4	4								
	3.4159 -	COLLAR, BLOWER HOUSING END PLATE SEAL RING														
	5110330	COLLAR		4	4		4	4								

3.4000 BLOWER

FIG	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	3.4160	SEAL, BLOWER HOUSING END PLATE														
	5138710	SEAL	4			4			4							
	5192438	SEAL (O.S.I.D., USE WITH 5192439 SPACER)	AR	AR	AR	AR	AR	AR	AR							
	5100617	SEAL		4	4		4	4								
	3.4163	SPACER, BLOWER ROTOR SHAFT OIL SEAL														
	5192439	SPACER (WEAR RING USE WITH 5192438 SEAL	AR	AR	AR	AR	AR	AR	AR							
	3.4180	COVER KIT, BLOWER END PLATE														
		KIT CONTAINS COVER ASSY. WHICH IS NOT SOLD SEPARATELY														
	5196760	COVER KIT (6V)	1						1							
	5196761	COVER KIT (8-16V)		1												
	5196762	COVER KIT (12V)			1											
	5196763	COVER KIT (12V)				1										
	5123445	* COVER, END PLATE			1											
	5123450	* COVER, END PLATE			1											
	5168749	PLUG, 7/8 -14 (TACH. DRIVE HOLE) (4.4160)	1	1		1										
	105456	GASKET (W/5168749 PLUG) (12.9360)	1	1		1										
	5126499	GASKET, COVER (3.4190)	1	1	2	1	1									
	5100901	SEAL, BLO. DR. COVER (4.56 I.D.X.62 WIDE) (3.4220)	1		2	2										
	5128633	SEAL, BLO. DR. COVER (4 1/2 I.D.X3 WIDE) (3.4220)		1												
	5124519	# SEAL RING (OIL SUPPLY TUBE) (3.4350)	1	1		1										
	5124521	# PLATE, REINFORCEMENT	1	1		1										
	5123849	PLATE, REINFORCEMENT (COVER)			2											
	5120645	CLAMP, BLO. DRIVE COVER (3.4227)		1												
	186643	BOLT, 5/16 -18X2 1/16 (12.9001)	10	10	16	10										
	179827	BOLT, 5/16 -18X2 1/4 (12.9001)	2	2												
	5124520	# WASHER, SEAL	1	1		1										
	5159714	WASHER (.328 I.D.X1/8) (2.7296)	10	10	16	10										
	103320	LOCKWASHER, 5/16 (12.9200)	10	10												

* EFF. WITH 12VA-132.

THRU 6VA-54306, 8VA-107423, 12VA-20732, 16VA-5164.

3.4000A BLOWER DRIVE SHAFT

3.4445 - SHAFT, BLOWER DRIVE

FIG	PART NUMBER		NAME AND DESCRIPTION	TYPES 18	19	20	21	22	23	27	30	32	45
4A	5117726		SHAFT (5 L.) (.625 DIA.) (12V) . .			1							
4A	5117724		SHAFT (5.22 L.) (.625 DIA.) . . . . (MARINE) (6V)	1									
4A	5162860		SHAFT (5.22 L.) (.625 DIA.) (6V) .								I		
4A	5124094	@	SHAFT (6.08 L.) (.625 DIA.) . . . . (MARINE) (6V)				I						
4A	5117725	*	SHAFT (7 L.) (.625 DIA.) (MARINE) . (8-16V)		1							1	
4A	5130295		SHAFT (7 L.) (.625 DIA.) (8V) . . .							I			
4A	5124095	@	SHAFT (7.86 L.) (.625 DIA.) . . . . (MARINE) (#) (8-16V)					1				1	
4A	5148253	&	SHAFT (5 L.) (.790 DIA.) . . . . . (NITRIDED) (12V)			1							
4A	5148255		SHAFT (5.86 L.) (.790 DIA.) . . . . (NITRIDED) (12V)						I				
4A	5141609		SHAFT (6.67 L.) (.790 DIA.) (8V) .										I
SHAFT	(5199273	&	SHAFT (7.00 L.) (.790 DIA.) (16V) .									1	
4A	5199274	&	SHAFT (7.86 L.) (.790 DIA.) (8V) .					1				1	

@ MARINE APPLICATION THRU
6VA-50621, 8VA-81196.
& OPTIONAL TO STANDARD SHAFT
IDENTIFIED # .

3.4446 - RING, BLOWER DRIVE SHAFT

FIG	PART NUMBER		NAME AND DESCRIPTION	TYPES 18	19	20	21	22	23	27	30	32	45
4B	5154637		RING, SNAP	1	1	1				1	1		1
4B	5167727	@	RING, SNAP				1	1	1			2	.

@ MARINE APPLICATION EFFECTIVE WITH
6VA-50622, 8VA-81197.

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover
2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls
3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler
4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System
5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter
6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections
7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid
8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines
9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission—Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car
10.0000	SHEET METAL
10.1000A	Engine Hood
11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base
12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits

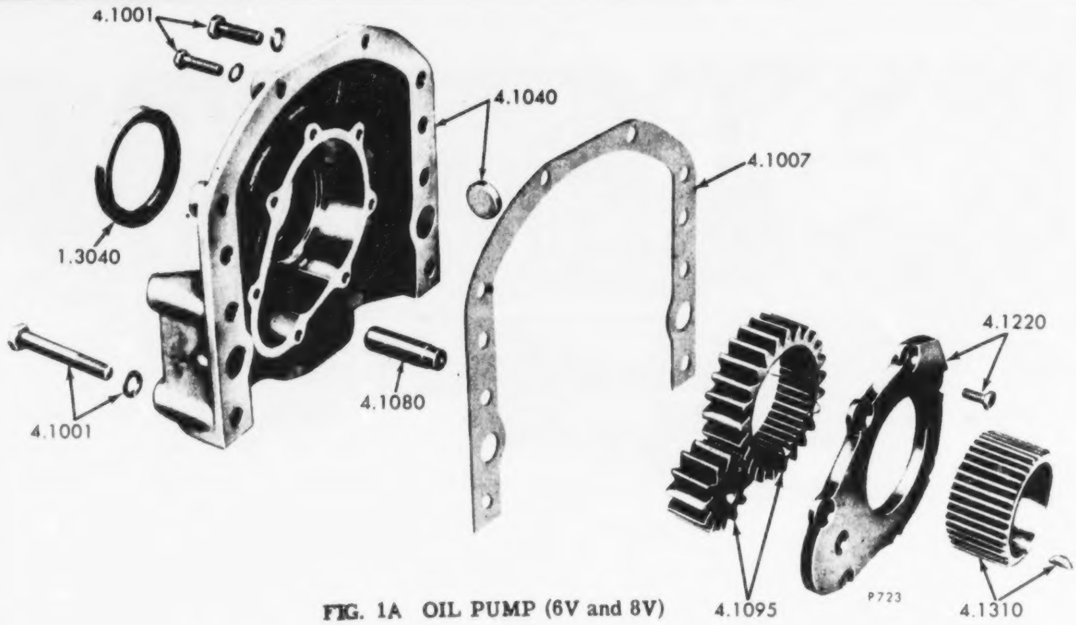

4.1001
4.1040
4.1007
1.3040
4.1220
4.1080
4.1001
4.1095
P723
4.1310

FIG. 1A OIL PUMP (6V and 8V)

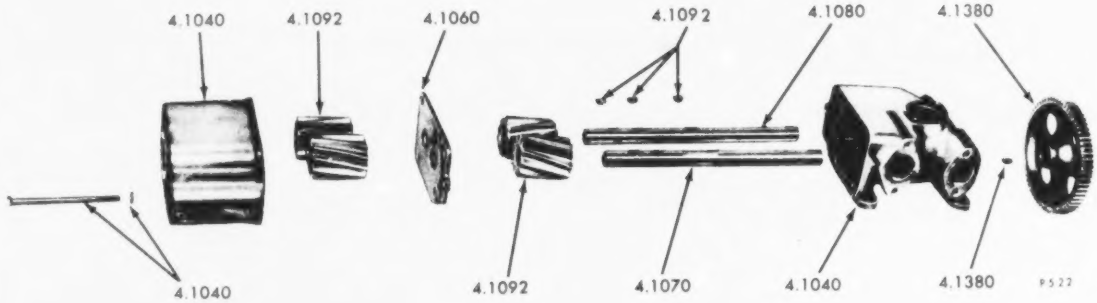

4.1040
4.1092
4.1060
4.1092
4.1080
4.1380
4.1040
4.1092
4.1070
4.1040
4.1380
P522

FIG. 1B OIL PUMP (Scavenging)

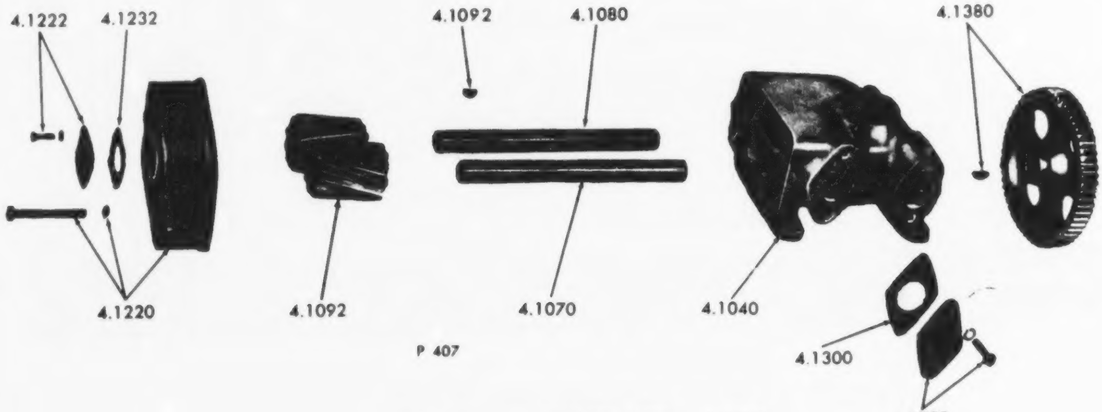

4.1222
4.1232
4.1092
4.1080
4.1380
4.1220
4.1092
4.1070
4.1040
P 407
4.1300
4.1290

FIG. 1C OIL PUMP (12V and 16V)

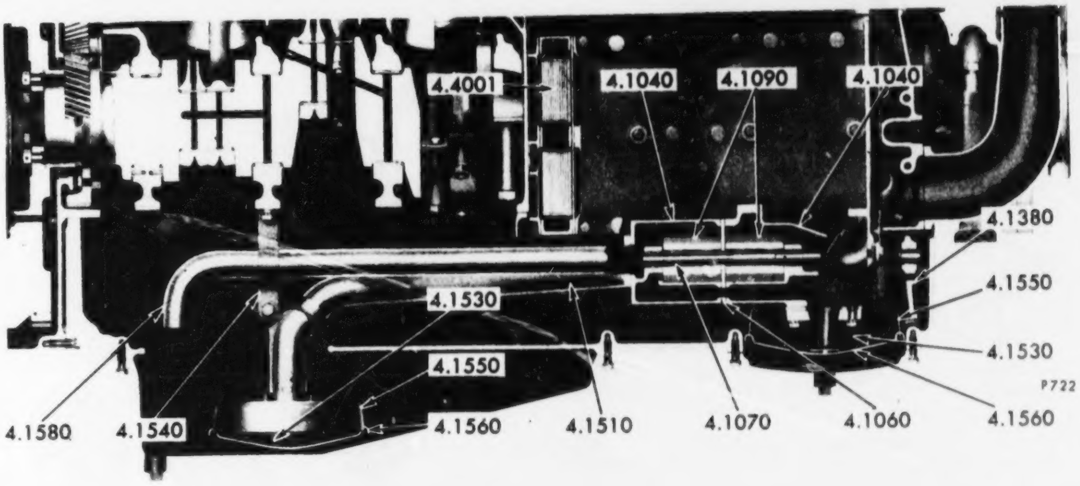

4.4001
4.1040
4.1090
4.1040
4.1380
4.1550
4.1530
4.1530
P722
4.1550
4.1580
4.1540
4.1560
4.1510
4.1070
4.1060
4.1560

FIG. 2A OIL DISTRIBUTION (12V)

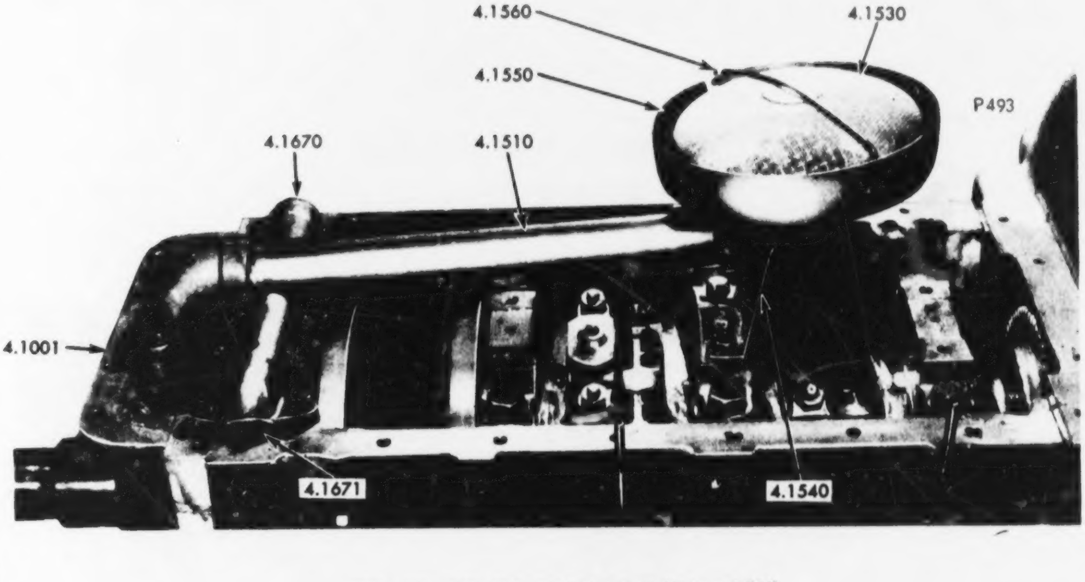

4.1560
4.1530
4.1550
P493
4.1670
4.1510
4.1001
4.1671
4.1540

FIG. 2B OIL DISTRIBUTION (6V and 8V)

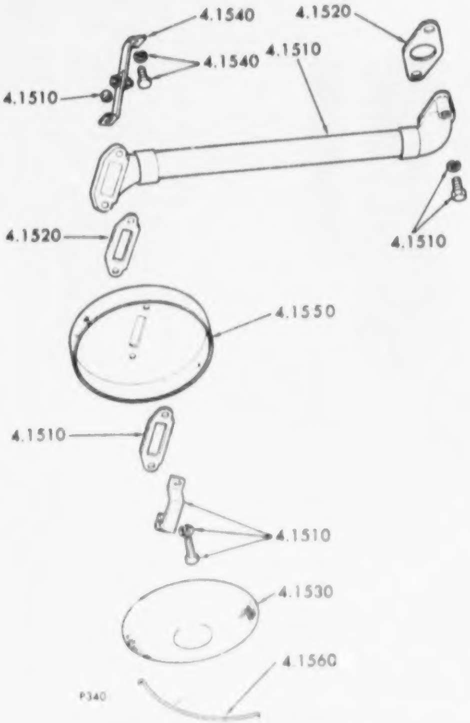

4.1540
4.1520
4.1540
4.1510
4.1510
4.1520
4.1510
4.1550
4.1510
4.1510
4.1530
4.1560
P340

FIG. 2C OIL DISTRIBUTION SYSTEM

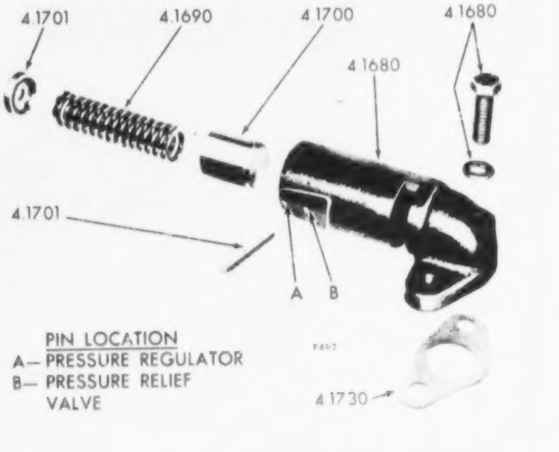

4.1701
4.1690
4.1700
4.1680
4.1680
4.1701
A
B
PIN LOCATION
A— PRESSURE REGULATOR
B— PRESSURE RELIEF VALVE
P492
4.1730

FIG. 3A (6 and 8V)

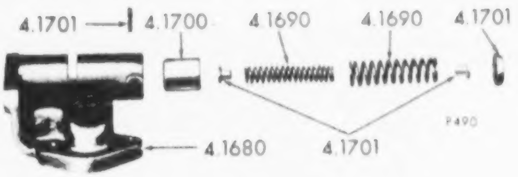

4.1701
4.1700
4.1690
4.1690
4.1701
4.1680
4.1701
P490

FIG. 3B (12V)

OIL PRESSURE REGULATOR OR RELIEF VALVE

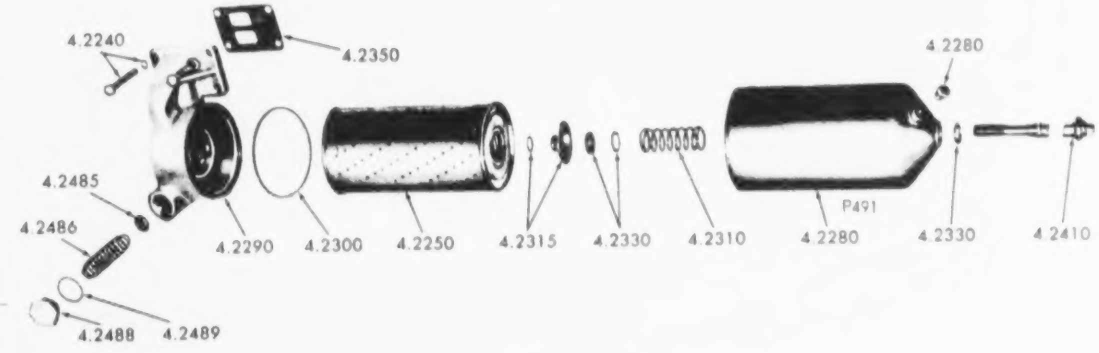

4.2240
4.2350
4.2280
4.2485
4.2486
4.2290
4.2300
4.2250
4.2315
4.2330
4.2310
P491
4.2280
4.2330
4.2410
4.2488
4.2489

FIG. 4A OIL FILTER

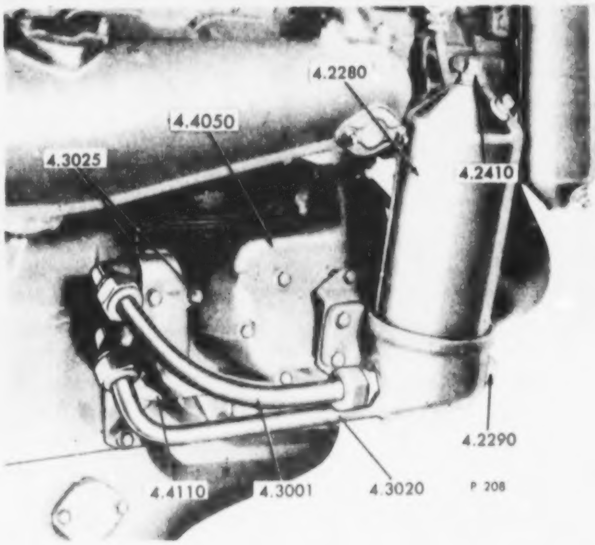

4.2280
4.4050
4.3025
4.2410
4.2290
4.4110
4.3001
4.3020
P 208

FIG. 4B OIL FILTER AND REMOTE ADAPTOR

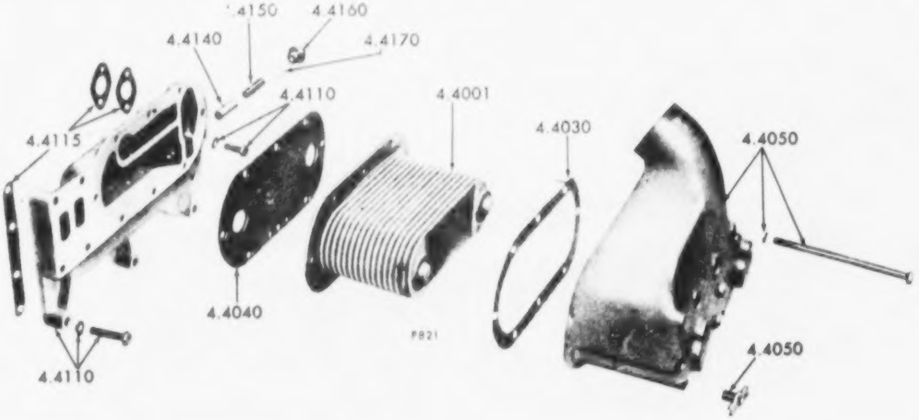

.4150
4.4160
4.4140
4.4170
4.4110
4.4001
4.4115
4.4030
4.4050
4.4040
P821
4.4050
4.4110

FIG. 5A OIL COOLER

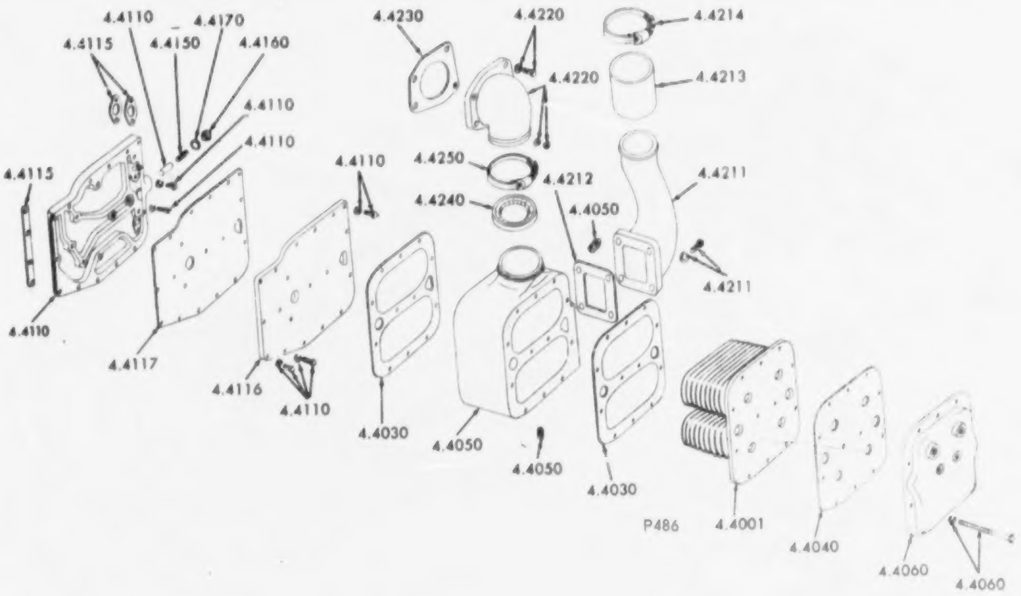

4.4110
4.4170
4.4115
4.4150
4.4160
4.4110
4.4110
4.4115
4.4110
4.4117
4.4116
4.4110
4.4230
4.4220
4.4214
4.4220
4.4213
4.4110
4.4250
4.4212
4.4211
4.4240
4.4050
4.4211
4.4030
4.4050
4.4050
4.4030
P486
4.4001
4.4040
4.4060
4.4060

FIG. 5B OIL FILTER AND OIL COOLER MOUNTING

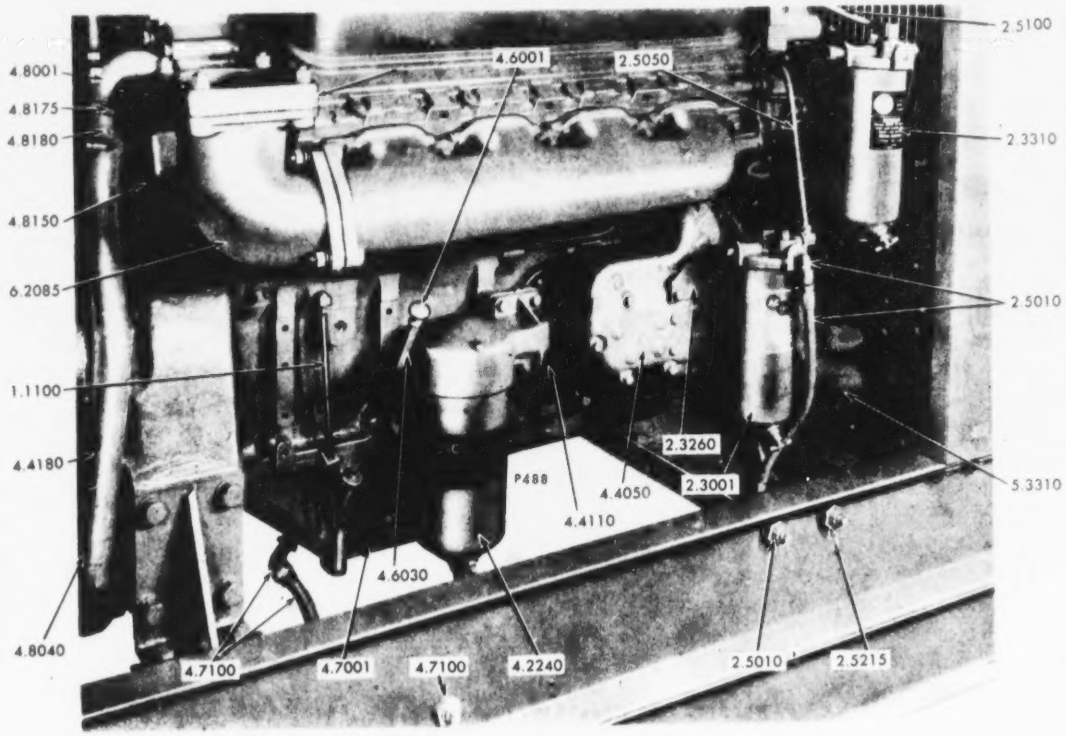

2.5100
4.8001
4.6001
2.5050
4.8175
4.8180
2.3310
4.8150
6.2085
2.5010
1.1100
2.3260
4.4180
P488
4.4050
2.3001
5.3310
4.4110
4.6030
4.8040
4.7100
4.7001
4.7100
4.2240
2.5010
2.5215

FIG. 5C OIL COOLER

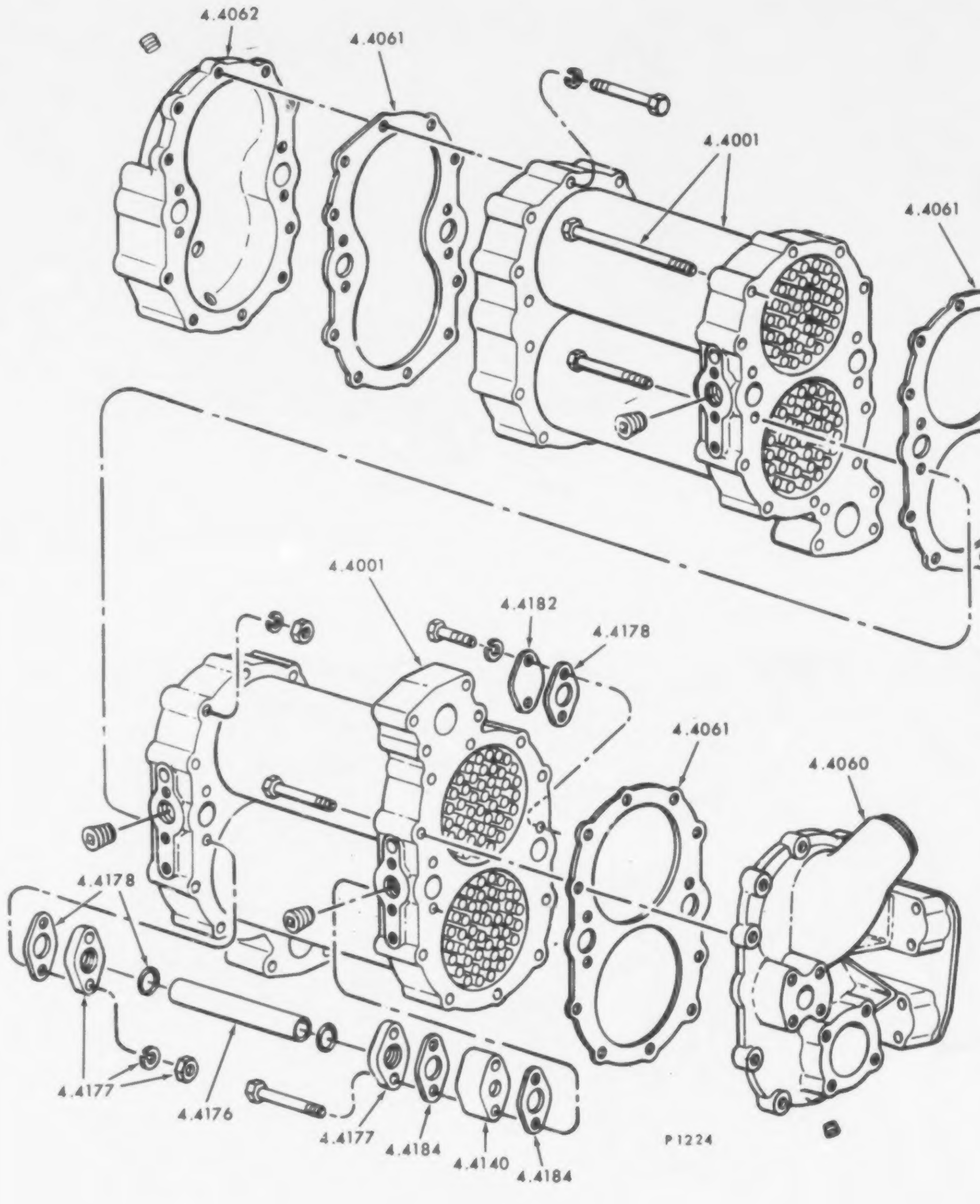

4.4062
4.4061
4.4001
4.4061
4.4001
4.4182
4.4178
4.4061
4.4060
4.4178
4.4177
4.4176
4.4177
4.4184
4.4140
4.4184
P1224

FIG. 5D - OIL COOLER (Tube Type)

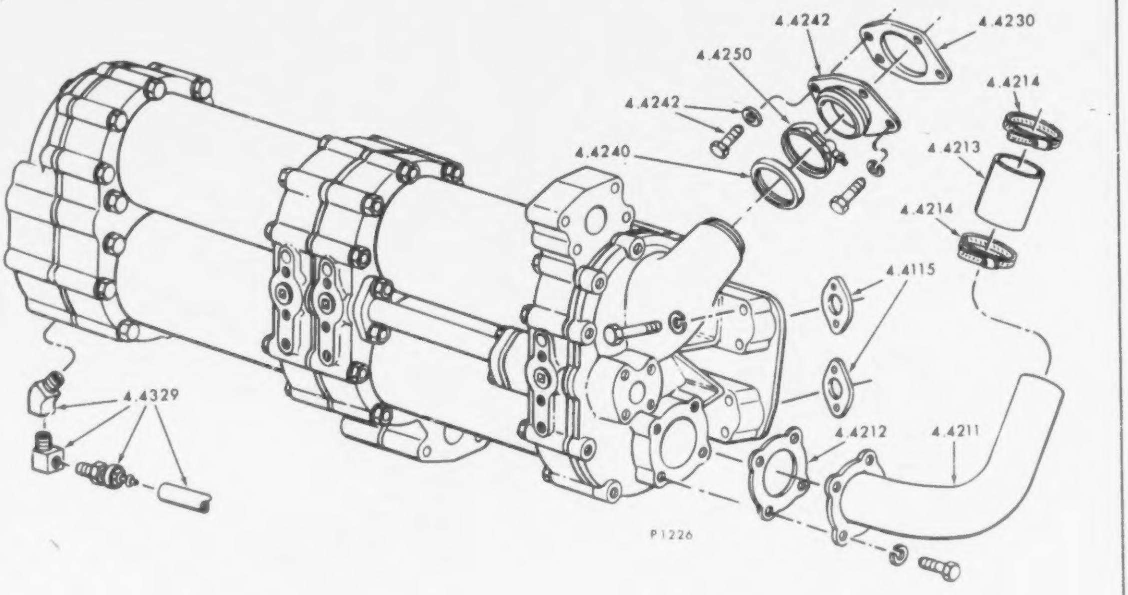

4.4242
4.4230
4.4250
4.4214
4.4242
4.4213
4.4240
4.4214
4.4115
4.4329
4.4212
4.4211
P1226

FIG. 5E - OIL COOLER ASSEMBLY

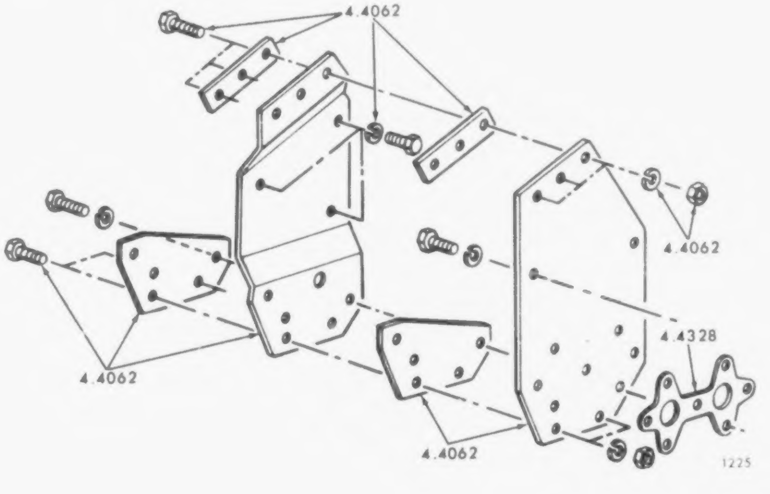

4.4062
4.4062
4.4062
4.4328
4.4062
1225

FIG. 5F - OIL COOLER MOUNTING BRACKET

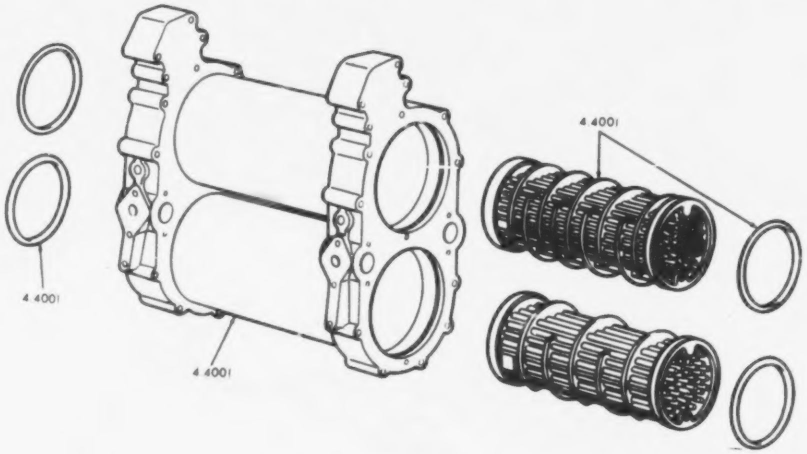

4.4001
4.4001
4.4001

FIG. 5G OIL COOLER TUBE TYPE

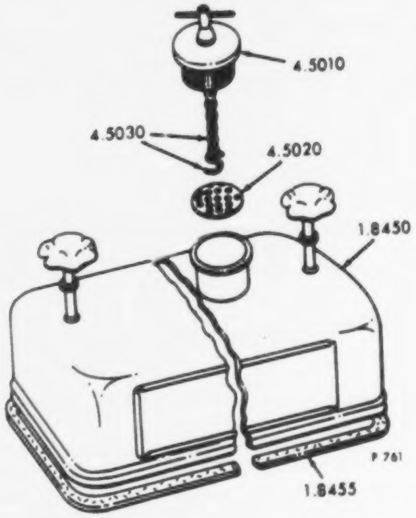

4.5010
4.5030
4.5020
1.8450
P 761
1.8455

FIG. 6A OIL FILLER CAP

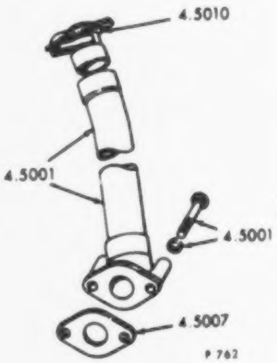

4.5010
4.5001
4.5001
4.5007
P 762

FIG. 6B FILLER NECK AND SPRING CAP

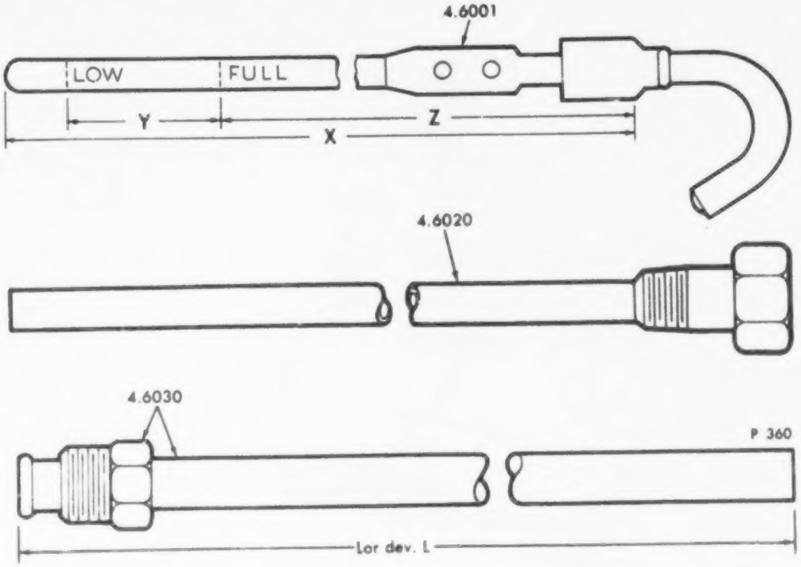

4.6001
LOW
FULL
Y
Z
X
4.6020
4.6030
P 360
Lor dev. L

FIG. 7A DIPSTICK

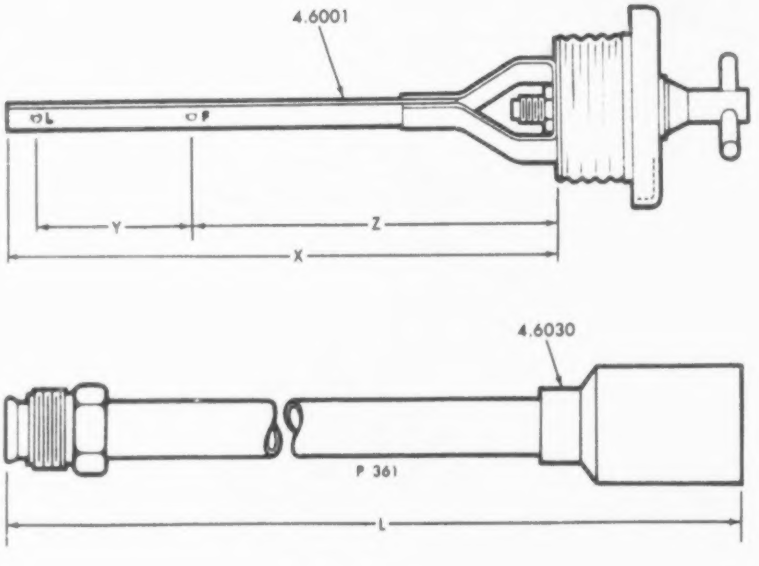

4.6001
L
F
Y
Z
X
4.6030
P 361
L

FIG. 7B DIPSTICK

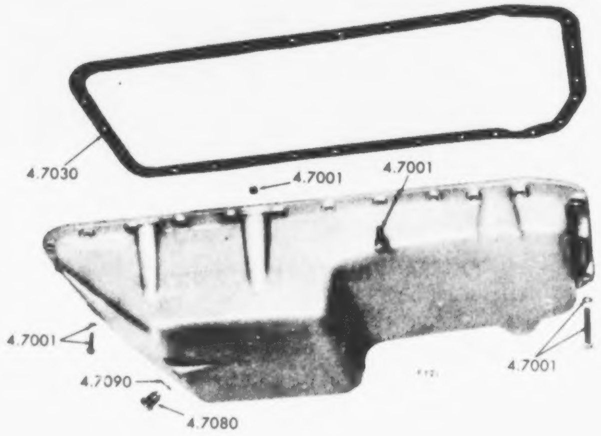

4.7030
4.7001
4.7001
4.7001
4.7001
4.7090
4.7080

FIG. 8A OIL PAN

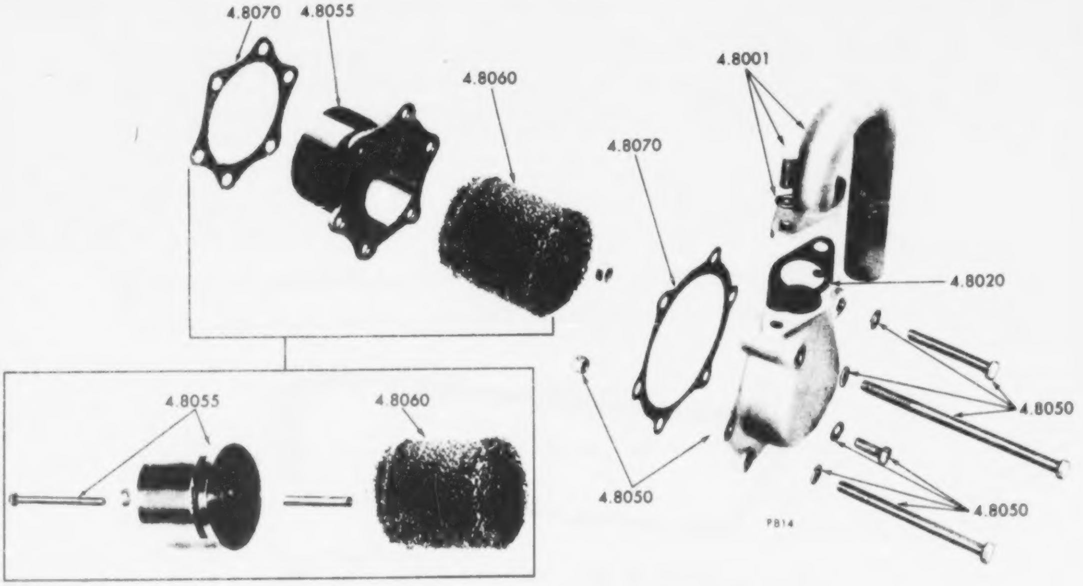

4.8070
4.8055
4.8060
4.8001
4.8070
4.8020
4.8055
4.8060
4.8050
4.8050
4.8050
P814

FIG. 9A VENTILATING SYSTEM

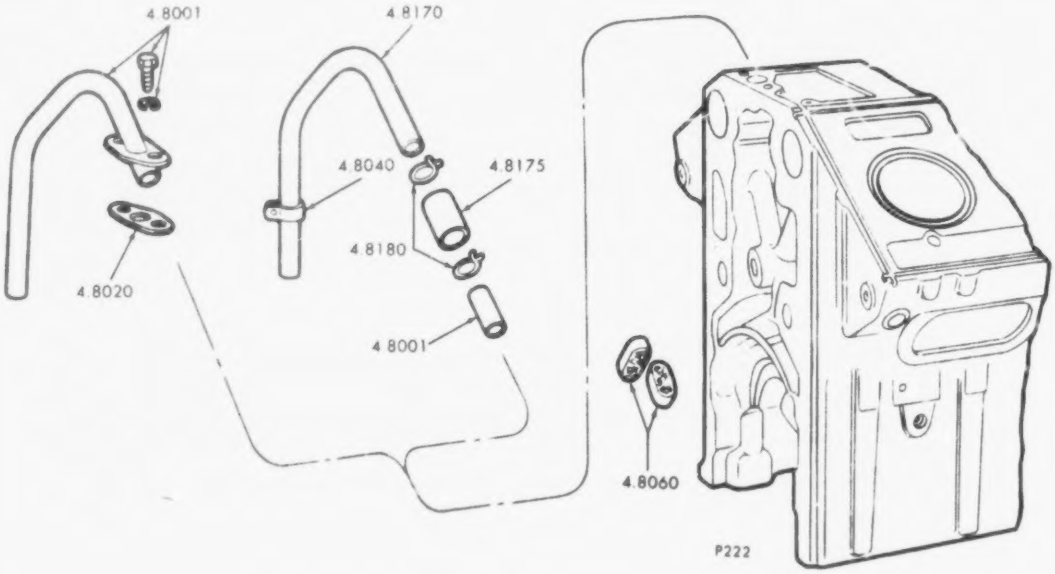

4.8001
4.8170
4.8040
4.8175
4.8180
4.8020
4.8001
4.8060
P222

FIG. 9B ENGINE BREATHER

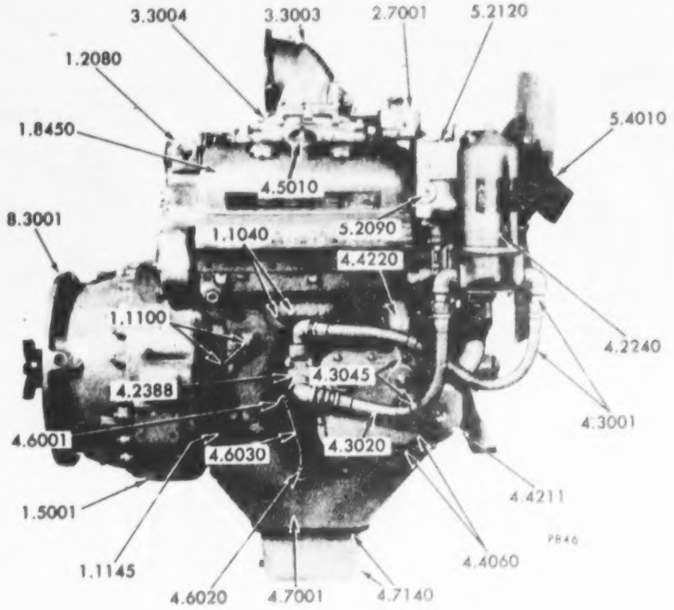

3.3004
3.3003
2.7001
5.2120
1.2080
1.8450
5.4010
4.5010
8.3001
1.1040
5.2090
4.4220
1.1100
4.2240
4.3045
4.2388
4.3001
4.6001
4.6030
4.3020
4.4211
1.5001
P846
4.4060
1.1145
4.6020
4.7001
4.7140

FIG. 10A TYPICAL 6V-71 TORQUE CONVERTER UNIT

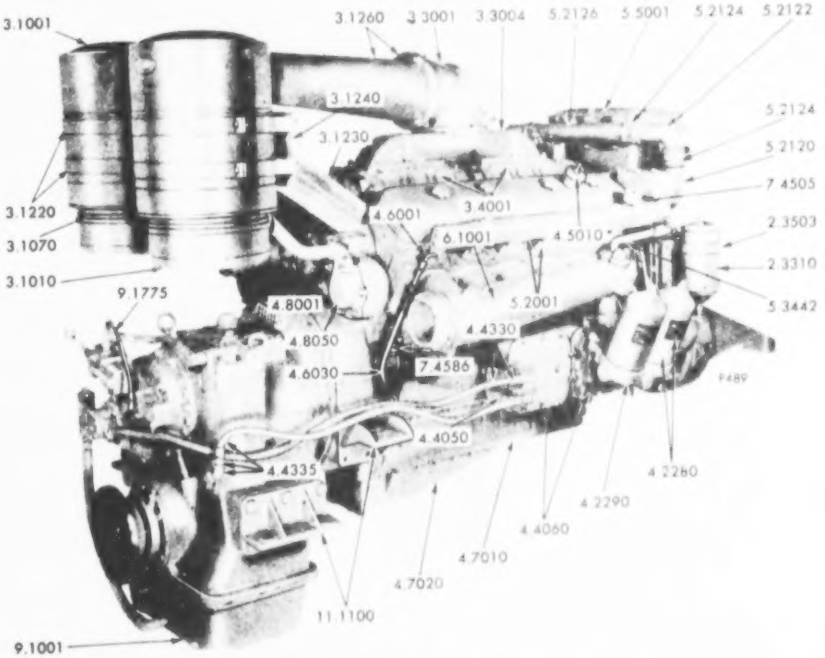

3.1001
3.1260
3.3001
3.3004
5.2126
5.5001
5.2124
5.2122
3.1240
5.2124
3.1230
5.2120
7.4505
3.1220
4.6001
3.4001
2.3503
3.1070
6.1001
4.5010
3.1010
2.3310
9.1775
5.2001
5.3442
4.8001
4.4330
4.8050
4.6030
7.4586
P489
4.4050
4.4335
4.2260
4.2290
4.4060
4.7010
4.7020
11.1100
9.1001

FIG. 10B TYPICAL 12V-71 MARINE (Work Boat)

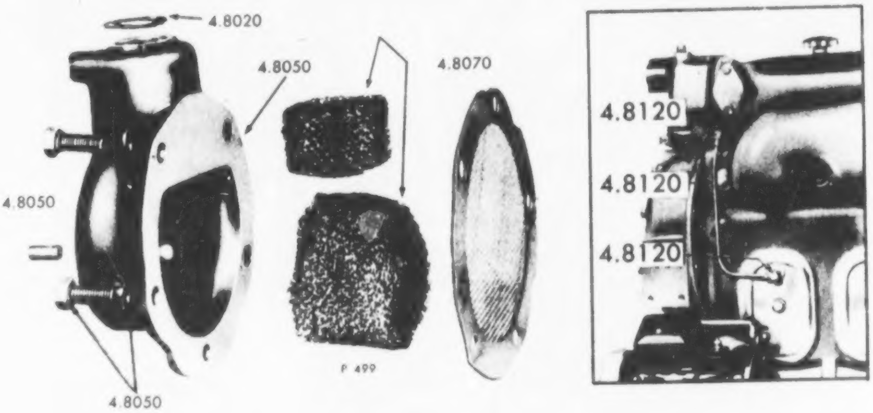

4.8020
4.8050
4.8070
4.8050
4.8050
P 499
4.8120
4.8120
4.8120

FIG. 9C VENTILATING SYSTEM

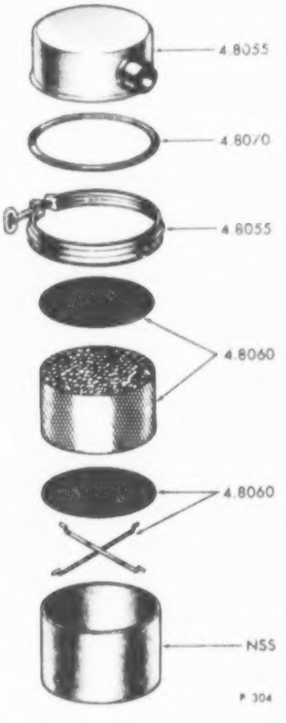

4.8055
4.8070
4.8055
4.8060
4.8060
NSS
P 304

FIG. 9D BREATHER ASSY.

4.1000A OIL PUMP

4.1001 - PUMP ASSY., OIL

SEE ASSEMBLY BREAKDOWN AS INDICATED.

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
1A	5102019	PUMP ASSY. (P.H.) (PAGE C1)							1		1
1A	5143052	PUMP ASSY. (R.H.) (PAGE B1)	1								
1A	5131147	PUMP ASSY. (R.H.) (PAGE C1)		1							
1A	5133341	PUMP ASSY. (R.H.) (PAGE C1)			1						
1C	5122233	PUMP ASSY. (L.H.) (PAGE A1)				1					
1B	5198840	PUMP ASSY. (R.H.) (SCAV.) (PAGE B1)					1			1	
1A	5136767	PUMP ASSY. (R.H.) (PAGE C1)						1			
1A	5146588	PUMP ASSY. (R.H.) (PAGE C1)									
	103156	STUD, 3/8 -16-24X1 9/16 (12.9117)					2			2	
	103157	STUD, 3/8 -16-24X1 13/16 (12.9117)					2			2	
	179844	BOLT, 3/8 -16X1 5/8 (12.9001)		2	2						
	186283	BOLT, 3/8 -16X3 1/2 (12.9001)							2		2
	214265	BOLT, 3/8 -16X3 3/4 (12.9001)	2					2			
	186646	BOLT, 1/2 -13X1 3/4 (12.9001)		2	2						
	179893	BOLT, 1/2 -13X3 (12.9001)							2		2
	190770	BOLT, 1/2 -13X3 1/4 (12.9001)		4	4						
	188659	BOLT, 1/2 -13X3 3/4 (12.9001)							4		4
	442734	BOLT, 1/2 -13X4 (12.9001)	6					6			
	103341	WASHER, 3/8 (12.9190)	2					2			
	103343	WASHER, 1/2 (12.9190)	6					6			
	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR	AR	AR	AR	AR	2	AR	AR
	103323	LOCKWASHER, 1/2 (12.9200)	6	6	6			6	8		6
	117049	NUT, 3/8 -24 HEX. (12.9120)				4	4			4	

4.1007 - GASKET, OIL PUMP TO CYLINDER BLOCK

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
1A	5121714	GASKET (1.3170)	1	1	1			1	1		1

4.1030 - SHIM, OIL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
	5183323	SHIM (.005)				1	1			1	
	5185319	SHIM (.010)				1	1			1	
	5185318	SHIM (.015)				1	1			1	

4.1232 - GASKET, OIL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
1C	5123235	GASKET (2.44 B.C.)				1					

4.1290 - COVER, OIL PUMP PAD

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
1C	5122680	COVER (2.40 B.C.) (SIDE)					1			1	
	5121926	COVER(2.44 B.C.)(OIL PUMP)(4.1222)				1					
1C	5123662	COVER (2.88 B.C.) (SIDE)				1					

4.1000A OIL PUMP

4.1290 - COVER, OIL PUMP PAD (CONT'D)

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
	5123949	COVER (INCLUDES NUT) (2.7630)					1				
	180078	BOLT, 5/16 -18X7/8 (12.9001)					2				
	446072	BOLT, 5/16 -24X1/2 (IN COVER) (12.9001)					1				
	180121	BOLT, 3/8 -16X7/8 CAD. (12.9001)				4	2				
	179838	BOLT, 3/8 -16X7/8 (12.9001)								2	
	5155596	WASHER, 5/16 COPPER (12.9190)					1				
	103320	LOCKWASHER, 5/16 (12.9200)					2				
	103321	LOCKWASHER, 3/8 (12.9200)				AR	2			2	

4.1300 - GASKET, OIL PUMP PAD COVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
	5123241	GASKET				1					
	5123240	GASKET					1			1	
	5152944	GASKET					1				

4.1310 - GEAR, OIL PUMP DRIVE (ON CRANKSHAFT)

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
1A	5136777	GEAR (37 TEETH)	1					1			
1A	5117020	GEAR (37 TEETH)		1	1				1		1
1A	5121958	GEAR (79 TEETH)					1				
	5124646	GEAR (86 TEETH)				1					
	5125558	GEAR (86 TEETH)								1	
1B	5126171	SPACER					1			1	
	5129681	BOLT, 5/16 -24X2 HEX. SOC.				6					

4.1380 - GEAR, OIL PUMP DRIVE (ON PUMP)

FIG.	PART NUMBER	NAME AND DESCRIPTION	113	114	115	117	125	127	131	132	136
1B	5127577	GEAR (57 TEETH)				1					
1B	5162749	GEAR (57 TEETH)								1	
1B	124549	KEY, 3/16 X3/4 WOODRUFF (12.9350)				1					
	223622	BOLT, 7/16 -20X4 (12.9001)								1	
	5188273	WASHER (6.1001)								1	

4.1000A OIL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		4.1001 - PUMP ASSY., OIL														
	5117608	PUMP ASSY. (L.H.) 6&8	1													
	5117609	PUMP ASSY. (R.H.) 6&8		1												
	5131147	PUMP ASSY. (R.H.) 8			1											
	5131533	PUMP ASSY. (R.H.) 6				1										
	5133341	PUMP ASSY. (R.H.) 6					1									
	5143052	PUMP ASSY. (R.H.) 12						1								
	5136787	PUMP ASSY. (R.H.) 8							1							
	5146588	PUMP ASSY. (R.H.) 6								1						
	5102019	PUMP ASSY. (R.H.) 6&8									1					
		4.1040 - BODY, OIL PUMP														
		AN ASSEMBLY INCLUDES SHAFT IN 4.1080.														
1A	5117610	BODY ASSY. (L.H.)	1													
1A	5146585	BODY ASSY. (R.H.) (INCLUDES PLUG)		1		1				1						
1A	5131148	BODY ASSY. (R.H.)			1											
	5133342	BODY ASSY.					1									
	5143053	BODY ASSY. (SCAVENGING)						1								
	5143051	BODY ASSY. (PRESSURE) (INCLUDES DOWEL)						1								
	5136773	BODY ASSY. (R.H.)							1							
	5143033	DOWEL (1.7004)						1								
	5102020	BODY ASSY.									1					
	5150014	PLUG, 1 1/4 CUP (OIL FILLER HOLE) (1.1001)		1		1				1	1					
	175826	BOLT, 5/16 -18X2 (12.9001)						7								
	103340	WASHER, 5/16 (12.9190)						7								
		4.1060 - SPACER, OIL PUMP BODY														
	5136786	SPACER							1							
		4.1080 - SHAFT, OIL PUMP DRIVEN GEAR														
1A	5117466	SHAFT	1	1	1	1	1			1	1					
		4.1090 - GEAR, OIL PUMP DRIVE														
	5117587	GEAR (1.302 WIDE)	1	1	1					1	1					
	5126670	GEAR (.581 WIDE)				1	1									
	5143228	GEAR						1								
	5143239	GEAR						1								
	5136756	GEAR							2							

4.1000A OIL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		4.1055 - GEAR SET, OIL PUMP														
		A SET INCLUDES ITEMS IN 4.1090 AND 4.1200.														
1A	5196602	GEAR SET (1.302 WIDE)	1	1	1											
1A	5196603	GEAR SET (.981 WIDE)				1	1									
		4.1200 - GEAR, OIL PUMP DRIVEN														
		A GEAR ASSY. INCLUDES BUSHING WHICH IS NOT SOLD SEPARATELY.														
	5117588	GEAR ASSY. (1.302 WIDE)	1	1	1					1	1					
	5126669	GEAR ASSY. (.981 WIDE)				1	1									
	5143230	GEAR						1								
	5143238	GEAR						1								
	5136798	GEAR							2							
		4.1220 - COVER, OIL PUMP														
1A	5117600	COVER (L.H.)	1													
1A	5117599	COVER (R.H.)		1	1	1	1			1	1					
	5143049	COVER & SHAFT ASSY. (INCLUDES DOWEL AND PLUG)						1								
	5136776	COVER & SHAFT ASSY. (INCLUDES DOWEL PINS)							1							
	5175630	DOWEL (1.1001)						1								
	141212	PIN, DOWEL 5/16 X5/16 (12.9290)							1							
	5151576	PIN, DOWEL 1/2 X1 3/8 (1.1001)							2							
	5145009	PLUG, 1/8 ALLEN HD. PIPE (12.9550)						1								
1A	9409011	BOLT, 5/16 -18X3/4 LOCK (12.9117)	8	8	8	8	8			8	8					
	186271	BOLT, 5/16 -18X3 3/4 (12.9001)						3								
	179848	BOLT, 3/8 -16X2 1/4 (12.9001)							3							
	5155596	WASHER, 5/16 (12.9190)						3								
	103341	WASHER, 3/8 (12.9190)							3							
	5150568	WASHER, 7/16 (2.4050)							3							
		4.1230 - GASKET, OIL PUMP COVER														
	5143058	SEAL						1								
	5115454	SEAL (1.3040)						1								
	5135344	SEAL							2							
	5136638	SLINGER (1.3050)						1	1							
		4.1250 - VALVE, OIL PUMP RELIEF														
	5175564	VALVE (PRESSURE AND RELIEF) (4.1700)						1	1							

4.1000B OIL DISTRIBUTION SYSTEM

4.1510 - PIPE, OIL PUMP INLET

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 438
2A	5144956	PIPE (12V-71)	
2A	5144761	PIPE (12V-71)	
2B	5146274	PIPE (8V-71)	
	5102973	PIPE (6V-71)	
2B,C	5125755	PIPE (6V-71)	1
	180121	BOLT, 3/8"-16X7/8" (12.9001)	
	186679	BOLT, 3/8"-16X1 1/4" (12.9001)	
	186622	BOLT, 3/8"-16X1 1/4" (12.9001)	2
	103321	LOCKWASHER, 3/8" (12.9200)	2

4.1520 - GASKET, OIL PUMP INLET PIPE

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 438
2C	5123660	GASKET (AT PUMP INLET) (4.1300)	
2C	5123240	GASKET (AT PUMP OUTLET) (4.1300)	
2C	5117269	GASKET (OUTLET TO BLOCK) (4.1720)	1
2C	5117242	GASKET (AT PUMP OUTLET)	1
2C	5167380	GASKET (AT PUMP INLET)	

4.1530 - SCREEN, OIL PUMP INLET

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 438
2A	5135603	SCREEN	1
2A	5101176	SCREEN	
2A	5126143	SCREEN	2
	5175705	SPACER (13/32"I.D.X7/8"O.D.X1")	
	9409010	BOLT, 5/16"-18X5/8" SELF LOCKING	
	180130	BOLT, 3/8"-16X2" (12.9001)	
	186282	BOLT, 3/8 -16X3 1/4 (12.9001)	2
	186283	BOLT, 3/8"-16X3 1/2" (12.9001)	
	120393	WASHER, 11/32"X11/16"	4
	103341	WASHER, 3/8" FLAT (12.9190)	2
	103321	LOCKWASHER, 3/8" (12.9200)	
	102635	NUT, 3/8"-16 HEX. (12.9120)	2
	123221	NUT, 3/8"-16 HEX. (12.9120)	

4.1540 - BRACKET, OIL PUMP SCREEN SUPPORT

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 438
2B	5146275	BRACKET	
2B	5103178	BRACKET	
2B	5138695	BRACKET	4
	5125752	BRACKET, SUPPORT	
	5108956	BRACKET, SUPPORT	
	180078	BOLT, 5/16"-18X7/8" (12.9001)	
	181596	BOLT, 5/16"-24X7/8" (12.9001)	2
	179838	BOLT, 3/8"-16X7/8" (12.9001)	
	180121	BOLT, 3/8"-16X7/8" (12.9001)	2
	181365	BOLT, 3/8"-24X1 1/8" (12.9001)	

4.1000B OIL DISTRIBUTION SYSTEM

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 438
		4.1540 - BRACKET, OIL PUMP SCREEN SUPPORT (CONT'D)	
	103340	WASHER, 5/16" PLAIN (12.9190)	
	103341	WASHER, 3/8" FLAT (12.9190)	10
	103320	LOCKWASHER, 5/16" (12.9200)	
	103321	LOCKWASHER, 3/8" (12.9200)	2
	214279	NUT, 5/16"-24 (12.9120)	
	192481	NUT, 3/8"-24 HEX. (12.9140)	2
		4.1550 - COVER, OIL PUMP INLET SCREEN	
2A,B,C	5118302	COVER	1
		4.1F - PIPE, OIL PUMP OUTLET	
2A	5145160	PIPE	
	180121	BOLT, 3/8"-16X7/8" (12.9001)	
	179846	BOLT, 3/8"-16X1 7/8" (12.9001)	
	103321	LOCKWASHER, 3/8" (12.9200)	
		4.1660 - PIPE, BLOWER DRIVE BEARING OIL	
*	5117717	PIPE (5/16"X4" L.) (TO BLOWER)	
*	114629	@ CONNECTOR, 5/16" BALL SLEEVE (12.9410)	
*	114631	@ SLEEVE, 5/16" BALL (12.9430)	
*	5124519	@ SEAL RING (1/8"X5/16") (3.4350)	
*	5124520	@ WASHER, SEAL (3.4180)	
*	114630	@ NUT, 5/16" BALL SLEEVE (12.9440)	
*	5144409	# ADAPTOR, BLOWER DRIVE TUBE	
*	5144477	# CONNECTOR	
*	5144424	# SEAL RING	
*	5144478	# NUT	
		* FIG. 4A OF 3.0000.	
		@ THRU 6VA-54306, 8VA-107423, 12VA-20732.	
		# EFF. WITH 6VA-54307, 8VA-107424, 12VA-20733.	

4.1000C OIL PRESSURE REGULATOR

4.1670 - REGULATOR, OIL PRESSURE

A REGULATOR ASSY. INCLUDES ITEMS IN 4.1680 THRU 4.1701.

FIG.	PART NUMBER	NAME AND DESCRIPTION	10	11	13	19	20
2B	5122896	REGULATOR ASSY. (PAN RAIL MOUNTED)	1				1
	5121954	REGULATOR ASSY. (VERTICAL PAN RAIL MTG.)		1	2	1	
	5137756	COVER, REGULATOR HOLE				1	
	179838	BOLT, 3/8 -16X7/8 (12.9001)				2	2
3A	179839	BOLT, 3/8 -16X1 (12.9001)	2	2	4	2	
	103341	WASHER, 3/8 FLAT (12.9190)				2	
3A	103321	LOCKWASHER, 3/8 (12.9200)	2	AR	AR	AR	AR

4.1671 - RELIEF VALVE, OIL PRESSURE

A RELIEF VALVE ASSY. INCLUDES ITEMS IN 4.1680 THRU 4.1701.

FIG.	PART NUMBER	NAME AND DESCRIPTION	10	11	13	19	20
2B,3A	5122895	RELIEF VALVE ASSY. (PAN RAIL MOUNTED)	1		1		1
3B	5126331	RELIEF VALVE ASSY.		1			
	5145161	PLATE, VALVE ADAPTOR					1
3A	179839	BOLT, 3/8 -16X1 (12.9001)	2	2	2		
	186619	BOLT, 3/8 -16X1 1/8 (12.9001)					2
	186622	BOLT, 3/8 -16X1 1/4 (12.9001)		2			
3A	103321	LOCKWASHER, 3/8 (12.9200)	2	AR	AR		AR

4.1680 - BODY, OIL PRESSURE REGULATOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	10	11	13	19	20
3A	5122894	BODY (PAN RAIL MOUNTED)	2		1		2
	5121953	BODY (VERTICAL PAN RAIL MOUNT)		1	2	1	
3B	5126328	BODY (RELIEF VALVE) (2 SPRING)		1			

4.1690 - SPRING, OIL PRESSURE REGULATOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	10	11	13	19	20
3B,3B	5126327	SPRING (.790 DIA.,-2.96 L.)	2	2	3	2	2
3B	5126326	SPRING (.520 DIA.,-2.57 L.)		1			

4.1700 - VALVE, OIL PRESSURE REGULATOR AND RELIEF

FIG.	PART NUMBER	NAME AND DESCRIPTION	10	11	13	19	20
3A,B	5117973	VALVE (1.20 L.)	2	2	3	2	2

4.1701 - SEAT, OIL PRESSURE REGULATOR AND RELIEF VALVE

FIG.	PART NUMBER	NAME AND DESCRIPTION	10	11	13	19	20
3A,B	5117957	SEAT (.22 L.)	2	2	3	2	2
3A,B	5126325	SEAT, SPRING (RELIEF VALVE)		2			
3A,B	457008	PIN, 3/16 X1 1/2 SPRING (12.9270)	2	2	3	2	2

4.1000C OIL PRESSURE REGULATOR

FIG	PART NUMBER	NAME AND DESCRIPTION	10	TYPES 111	13	119	20
		4.1730 - GASKET, OIL PRESSURE REGULATOR BODY					
3A	5117269	GASKET	2	2	3	2	2
	5123240	GASKET (RELIEF VALVE TO PUMP) (4.1300)		1			

4.2000A OIL FILTER

4.2240 - FILTER, OIL

SEE ASSEMBLY BREAKDOWN PAGES AS INDICATED BELOW.

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	195	200	204	207	208	211	212	213	214	215
5B	5129656	* FILTER ASSY. (FULL FLOW) (PAGE A3) . (5134553)	1										
5B	5125384	* FILTER ASSY. (FULL FLOW) (PAGE A1) . (5147683)											1
	5181797	* FILTER ASSY. (FULL FLOW) (PAGE A1) . (5147683)						1			1	1	
5B	5135056	* FILTER ASSY. (FULL FLOW) (PAGE A3) . (5135163)			1								
5B	5134553	FILTER ASSY. (FULL FLOW) (PAGE B1)				1							
	5136006	FILTER ASSY. (FULL FLOW) (PAGE A3) .					1						
	5135163	FILTER ASSY. (FULL FLOW) (PAGE A3) .							1				
	128003	BUSHING, 1 X3/4 RED. (12.9550) . . .					1						
	5573162	DECAL (FULL FLOW FILTER) (4.2280) . .	1			1	1	1			1	1	1
	5579405	DECAL (4.2280)			1				1				
	5145013	PLUG, 3/4 PIPE (12.9550)			1								
	5111798	PLUG, 1 PIPE (12.9550)					1						
4A	186628	BOLT, 3/8 -16X1 1/2" (12.9001) . . .	2		3	3	4		3		4	4	
4A	427588	BOLT, 3/8 -16X2 1/2 (12.9001) . . .			1	1			1				
	455537	BOLT, 3/8 -16X4 (12.9001)	1										
	9419864	BOLT, 3/8 -16X5 (12.9001)	1										
	181361	BOLT, 3/8 -24X7/8 (12.9001)						4					
4A	103321	LOCKWASHER, 3/8 (12.9200)	4		4	4	4	4	4		4	4	
	123221	NUT, 3/8 -16 HEX. (12.9120)					4						

* NOT SERVICED AS AN ASSEMBLY COMPONENTS ARE AVAILABLE. FOR COMPLETE REPLACEMENT USE PART NUMBER SHOWN IN PARENTHESES PLUS (2) 5111798 PLUGS AND (2) 128003 BUSHINGS.

4.2250 - ELEMENT, OIL FILTER

INCLUDES GASKET IN 4.2300.

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	195	200	204	207	208	211	212	213	214	215
4A	5573014	ELEMENT (AC TYPE PF-132) (PAPER) . . (FULL FLOW)		2						1			

4.2280 - SHELL, OIL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	195	200	204	207	208	211	212	213	214	215
4A	5574008	SHELL (AC TYPE OF-203) (INCLUDES . . PLUG)		2						1			
	5570480	PLUG (DRAIN) (2.3050)		2						1			
	5573162	DECAL								1			

FIG.	PART NUMBER	NAME AND DESCRIPTION	193	195	200	204	207	208	211	212	213	214	215
		4.2290 - COVER, OIL FILTER											
	5132361	COVER (FRONT)		1									
	5132360	COVER (REAR)		1									
	5144212	COVER (ADAPTOR)								1			
	5145010	PLUG, 1/4 PIPE (12.9550)		2									
	272545	BOLT, 5/16 -18X5 1/4 (12.9001)		20									
	455971	BOLT, 5/16 -18X5 1/2 (12.9001)		4									
	454906	BOLT, 3/8 -16X1 1/2 (12.9001)								3			
	214265	BOLT, 3/8 -16X3 3/4 (12.9001)								1			
	103320	LOCKWASHER, 5/16 (12.9200)		24									
	103321	LOCKWASHER, 3/8 (12.9200)								4			
		4.2291 - ADAPTOR, OIL FILTER COVER											
	5133084	ADAPTOR (MOUNTING) (4.2290)	1										
	186679	BOLT, 3/8 -16X1 1/4 (12.9001)	1										
	427588	BOLT, 3/8 -16X2 1/2 (12.9001)	1										
	103321	LOCKWASHER, 3/8 (12.9200)	AR										
		4.2300 - GASKET, OIL FILTER COVER											
4A	5571024	GASKET		2						1			
		4.2310 - SPRING, OIL FILTER											
4A	5187308	SPRING		2						1			
		4.2315 - RETAINER, OIL FILTER SPRING											
4A	5187309	RETAINER		2						1			
	122366	* NUT, 5/8 -18 HEX. (12.9120) * EFFECTIVE WITH 12VA-2564.		2						1			
		4.2330 - GASKET, OIL FILTER COVER NUT											
4A	5187310	GASKET		2						1			
4A	6437298	GASKET		2						1			
4A	5154538	GASKET (1.8182)		2									
		4.2350 - GASKET, OIL FILTER ADAPTOR											
	5123932-	GASKET (FILTER TO ADAPTOR)	1		1	1			1	1			
	5117487	GASKET (ADAPTOR TO BLOCK)	1										
	5187312	GASKET		2									

4.2000A OIL FILTER

4.2240 - FILTER ASSEMBLY

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	2325391	FILTER ASSY. (BY-PASS)						1								
	2420014	FILTER ASSY. (BY-PASS)			1											
	5121120	* FILTER ASSY. (FULL FLOW)		1												
	5199767	FILTER ASSY. (FULL FLOW)				1										
	5129656	* FILTER ASSY. (FULL FLOW)	1													
	5134553	FILTER ASSY. (FULL FLOW)								1						
	5135056	FILTER ASSY. (FULL FLOW)							1							
	5135163	FILTER ASSY. (FULL FLOW)										1				
	5136006	FILTER ASSY. (FULL FLOW)									1					
	5572941	FILTER ASSY. (BY-PASS)					1									
		* NOT SERVICED LISTED FOR REFERENCE ONLY.														

4.2250 - ELEMENT, OIL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4A	5573014	ELEMENT (AC TYPE PF-132) (INCLUDES GASKET IN 4.2300)	1	1		2			1	1	1	1				
	5572856	ELEMENT			1											
	5572425	ELEMENT (AC TYPE P-117) (BY-PASS)					1									
	5573898	ELEMENT (AC TYPE C-267) (BY-PASS)						1								

4.2280 - SHELL, OIL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4A	5574008	SHELL (INCLUDES PLUG) (AC TYPE CF-203)	1	1		2	1			1	1					
	2419674	SHELL			1											
	5576926	SHELL							1			1				
4A	5570480	PLUG (DRAIN) (2.3050)	1	1	1	2	1									

4.2290 - ADAPTOR, OIL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	5124977	* ADAPTOR	1						1							
	5121124	* ADAPTOR		1												
	2398708	ADAPTOR			1											
	5123810	ADAPTOR				1										
	5134310	ADAPTOR								1		1				
	5125383	@ ADAPTOR									1					
	5571505	BASE					1									
	5571540	TUBE (IN BASE)					2									
	5145010	PLUG, 1/4 SQ. HD. PIPE (12.9550)		2	1	2	2				2					
	5145011	PLUG, 3/8 PIPE (12.9550)				1										
	5142549	PLUG, 3/4 PIPE (12.9550)				2										
	5154205	NUT (SLEEVE) (4.2280)			1											
		* NOT SERVICED, REPLACE WITH 5134310 ADAPTOR AND INCLUDE 1-5198303 VALVE KIT.														

4.2000A OIL FILTER

4.2290 - ADAPTOR, OIL FILTER (CONT'D)

NOT SERVICED, REPLACE WITH
5134906 ADAPTOR AND INCLUDE
1-5198303 VALVE KIT.
@ NOT SERVICED. REPLACED BY 5147684
PLUS (2) 5111798 PLUGS AND (2)
128003 BUSHINGS.

4.2300 - GASKET, OIL FILTER COVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4A	5571024	GASKET	1	1		2	1		1	1	1	1				
	1504107	GASKET			1											
	2399076	GASKET			1											

4.2310 - SPRING, OIL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4A	5187308	SPRING	1	1		2				1	1					
	5573089	SPRING			1											
	1503518	SPRING					1									
	5109692	SPRING							1			1				

4.2315 - RETAINER, OIL FILTER SPRING

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4A	5187309	RETAINER	1	1		2			1	1	1	1				
	2367414	RETAINER			1											
4A	5120602	* RING, RETAINER SNAP (2.4427)	1	1		2										
	122366	NUT, 5/8 -18 HEX. (12.9120) * THRU 6VA-17732, 8VA-8325, 12VA-2563, 16VA-168.	1	1		2			1	1	1	1				

4.2330 - GASKET, OIL FILTER COVER NUT

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4A	5187310	GASKET (RETAINER) (FULL FLOW FILTER)	1	1		2			1	1	1	1				
4A	6437258	GASKET (FULL FLOW FILTER)	1	1		2	1		1	1	1	1				
	2399075	GASKET (STUD)			1											
4A	5154538	WASHER (1.8182)	1	1		2			1	1	1	1				
	2359398	WASHER (1.120 O.D.X.780 I.D.)			1											

4.2410 - STUD, OIL FILTER CENTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4A	5120740	STUD	1	1		2				1	1					
	2399121	STUD			1											
	1595893	STUD					1									

4.2000A OIL FILTER

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		4.2410 - STUD, OIL FILTER CENTER (CONT'D)														
	5109659	STUD							1			1				
		4.2485 - VALVE, OIL FILTER BY-PASS														
4A	5575088	VALVE		1		1										
	5133431	VALVE	1						1	1		1				
	9406220	SCREW, #8-32X5/16 SELF TAPPING (12.9065)	1													
		4.2486 - SPRING, OIL FILTER BY-PASS														
4A	5575680	SPRING		1					1							
4A	5575087	SPRING				1										
4A	5134477	SPRING	1							1		1				
	454747	@ BOLT, 1/4 -28X1/2 (12.9025) @ REQUIRED ONLY WHEN RETAINER SCREW HOLE IS THREADED.	1													
		4.2488 - PLUG, OIL FILTER BY-PASS														
	5126686	PLUG					1									
	5574736	RETAINER		1												
	5134456	RETAINER	1						1	1		1				
	9406220	SCREW, #8-32X5/16 RD. HD. (12.9065)		1												
	160221	SCREW, #12-24X1/2 (12.9065)	1						1	1		1				
	454745	@ BOLT, 1/4 -28X1/2 (12.9025) @ REQUIRED ONLY WHEN RETAINER SCREW HOLE IS THREADED.	1						1	1		1				
		4.2489 - GASKET, OIL FILTER BY-PASS PLUG														
-	5575086	GASKET					1									

4.4000A OIL COOLER

TYPES

4.4001 - CORE, OIL COOLER

FIG	PART NUMBER	NAME AND DESCRIPTION	672
5A	8514600	CORE ASSY. (12 PLATES)	1
5C	8429663	CORE ASSY. (24 PLATES)	
5C	8529663	CORE ASSY. (24 PLATES)	
5A	8428885	CORE ASSY. (16 PLATES)	
5A	8531655	CORE ASSY. (16 PLATES)	
	8537752	CORE ASSY.	
	122017	BOLT, 5/16"-18X1" (12.9001)	
	446202	WASHER, 5/16" FLAT (12.9190)	

4.4030 - GASKET, OIL COOLER CORE-INNER

FIG	PART NUMBER	NAME AND DESCRIPTION	672
5A	5150155	GASKET	1
5C	5117280	GASKET	
5C	5117404	GASKET (4.4115)	
	5117535	GASKET (4.4117)	
5C	5122836	GASKET	
	5144816	GASKET	

4.4040 - GASKET, OIL COOLER CORE-OUTER

FIG	PART NUMBER	NAME AND DESCRIPTION	672
5A	5154215	GASKET	1
5C	5117280	GASKET (4.4030)	
	5122835	GASKET	
	5144815	GASKET (4.4115)	
	5145026	GASKET	

4.4050 - HOUSING, OIL COOLER

FIG	PART NUMBER	NAME AND DESCRIPTION	672
	5131279	HOUSING	1
5C	5117690	HOUSING	
	5117824 *	HOUSING	
	5123391 @	HOUSING	
	5122832	HOUSING	
	5144812	HOUSING	
5A,C	103647	DRAINCOCK, 1/4" (12.9510)	1
	5132634	DECAL, DRAIN DIRECTIONAL (1.1001)	1
	180083	BOLT, 5/16"-18X1 1/2" (12.9001)	
	186270	BOLT, 5/16"-18X3 1/2" (12.9001)	
	186650	BOLT, 5/16"-18X4 3/4" (12.9001)	
	186274	BOLT, 5/16"-18X5" (12.9001)	8
5A	215404	BOLT, 5/16"-18X5 3/4" (12.9001)	
5A	103320	LOCKWASHER, 5/16" (12.9200)	8
		* NOT SERVICED, USE 5129421. WHEN REPLACING 5117824 WITH 5129421 FOR THE 6V-71, INCLUDE 1-8528885 16 PLATE ELEMENT.	

4.4000A OIL COOLER

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 572
		4.4050 - HOUSING, OIL COOLER (CONT'D)	
		® NOT SERVICED, USE 5123390 AND 2-5176829.	
		4.4060 - COVER, OIL COOLER HOUSING	
5C	5101742	COVER (FRONT)	
	272545	BOLT, 5/16"-18X5 1/4" (12.9001)	
	103320	LOCKWASHER, 5/16" (12.9200)	
		4.4061 - GASKET, OIL COOLER HOUSING COVER	
	5175846	GASKET (4.4040)	
		4.4110 - ADAPTOR ASSY., OIL COOLER	
5A	51022d4	ADAPTOR	1
5C	5122850	ADAPTOR	
5C	5117680	ADAPTOR	
5A	5123393	ADAPTOR	
5A	5122831	ADAPTOR	
	5144811	ADAPTOR	
	5126323	SHIM, 5/16"O.D., 3/32"I.D. (.012" THK.) (4.4115)	
	179839	BOLT, 3/8"-16X1" (12.9001)	
	186619	BOLT, 3/8"-16X1 1/8" (12.9001)	1
	186679	BOLT, 3/8"-16X1 1/4" (12.9001)	
	138243	BOLT, 3/8"-16X1 1/4" (12.9001)	
	186612	BOLT, 3/8"-16X1 3/8" (12.9001)	
5A,C	454906	BOLT, 3/8"-16X1 1/2" (12.9001)	2
5A	179846	BOLT, 3/8"-16X1 7/8" (12.9001)	5
	5152148	WASHER, 3/8" FLAT (COPPER) (2.4050)	1
5A,C	103321	LOCKWASHER, 3/8" (12.9200)	7
		+ NOT SERVICED, USE 5101427, 5101428, 5102271, 2-186618, 2-103320	
		4.4115 - GASKET, OIL COOLER ADAPTOR TO BLOCK	
5A,C,E	5117535	GASKET (4.4117)	2
5A,C	5152904	GASKET	
5A,C	5126280	SPACER (8.20"L.)	2
		4.4116 - COVER, OIL COOLER ADAPTOR	
	5102265	COVER (PLATE)	1
5C	5122851	COVER (PLATE)	
5C	5130374	COVER (PLATE)	
5C	186625	BOLT, 5/16"-18X7/8" (12.9001)	5

4.4000A OIL COOLER

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 572
	4.4116	**COVER, OIL COOLER ADAPTOR (CONT'D)**	
5C	103320	LOCKWASHER, 5/16" (12.9200)	6
	4.4117	**GASKET, OIL COOLER ADAPTOR COVER**	
	5122852	GASKET	
	5117711	GASKET	
	5117535	GASKET	
	5152904	GASKET (4.4115)	
	5102342	GASKET	1
	4.4140	**VALVE, OIL COOLER BY-PASS**	
5A,C	5177777	VALVE	1
	4.4150	**SPRING, OIL COOLER BY-PASS VALVE**	
5A,C	5177778	SPRING (4.1260)	1
	4.4160	**PLUG, OIL COOLER BY-PASS VALVE**	
5A,C	5177772	PLUG	1
	4.4170	**GASKET, OIL COOLER BY-PASS VALVE PLUG**	
5A,C	5177773	GASKET	1
	4.4211	**CONNECTION, OIL COOLER WATER INLET**	
5C	5127199	ELBOW	1
	5134620	ELBOW	
	5122422	ELBOW	
5C	5122834	ELBOW	
5C	5144813	ELBOW	
5C	5144814	ELBOW	
5C	5145239	ELBOW	
	5121182	PLUG, 1/4" SQ. HD. (12.9550)	
	5145012	PLUG, 1/2" PIPE (12.9550)	2
	5115214	PLUG, 1/2" PIPE (12.9550)	
5C	186619	BOLT, 3/8"-16X1 1/8" (12.9001)	3
	179858	BOLT, 7/16"-14X1" (12.9001)	
5C	103321	LOCKWASHER, 3/8" (12.9200)	3
	103322	LOCKWASHER, 7/16" (12.9200)	

4.4000A OIL COOLER

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 572
	4.4211	**CONNECTION, OIL COOLER WATER INLET (CONT'D)**	
	117050	NUT, 7/16"-20 HEX. (12.9120)	
		* NOT SERVICED, USE 5140360 AND 2-5145012.	
	4.4212	**GASKET, OIL COOLER WATER INLET CONNECTION**	
5C	5117476	GASKET	1
5C	5117317	GASKET	
5C	5129515	GASKET (4.5007)	
5C	5144817	GASKET (ELBOW TO HOUSING)	
	4.4213	**HOSE, OIL COOLER WATER INLET**	
	695615	HOSE (2 3/8"I.D.X2 76"L.)	
5C	5199780	HOSE (2 3/8"I.D.X 2.76"L.)(TO WATER PUMP) (5.3365)	1
5C	5147744	HOSE (2 7/8"I.D.X4 1/2"L.) (TO WATER PUMP)	
	4.4214	**CLAMP, OIL COOLER WATER INLET HOSE**	
*,5C	9139809	CLAMP (2 1/16"-3" RANGE) (12.9660)	2
5C	5145033	CLAMP (2 9/16"-2 7/8" RANGE) (T-BOLT W/SPRING) (5.2124)	
5E	5188036	CLAMP (2 9/16"-3 1/2" RANGE) (12.9660)	
		* FIG. 10C OF 5.0000	
	4.4220	**ELBOW, OIL COOLER WATER OUTLET**	
5C	5117255 *	ELBOW (OUTLET)	
5C	5129834	ELBOW (OUTLET)	
5C	5137063	ELBOW (OUTLET)	
	5142549	PLUG, 3/4" PIPE (12.9550)	
5C	179839	BOLT, 3/8"-16X1" (12.9001)	
5C	186679	BOLT, 3/8"-16X1 1/4" (12.9001)	
5C	5152148	WASHER, 3/8" FLAT (COPPER) (2.4050)	
5C	103321	LOCKWASHER, 3/8" (12.9200)	
5C	117049	NUT, 3/8"-24 HEX. (12.9120)	
		* NOT SERVICED, FOR SERVICE USE 5129834 AND 5142549.	

4.4000A OIL COOLER

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES 572
		4.4230 - GASKET, OIL COOLER WATER ELBOW	
5C,E	5117254	GASKET	
		4.4240 - HOSE, OIL COOLER WATER OUTLET	
5C,E	5144078	SEAL (3.60"O.D.X.62"W.)	
		4.4242 - FLANGE, OIL COOLER WATER OUTLET	
	5125598	FLANGE (4.4320)	1
	186622	BOLT, 3/8"-16X1 1/4" (12.9001)	2
	186679	BOLT, 3/8"-16X1 1/4" (12.9001)	
	103321	LOCKWASHER, 3/8" (12.9200)	4
	117049	NUT 3/8"-24 HEX. (12.9120)	2
		4.4244 - GASKET, OIL COOLER WATER OUTLET FLANGE	
	5125599	SEAL RING	1
		4.4250 - CLAMP, OIL COOLER WATER OUTLET HOSE	
5C	5143999	CLAMP, 3 1/2"I.D. HOSE	

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4.5000A OIL FILLER

4.5001 - TUBE, OIL FILLER

FIG.	PART NUMBER	NAME AND DESCRIPTION	14	20	46	47	52	57	58	62	63	64	66	69
	5161999	TUBE		1										
	5124619	+ TUBE					1							
	5128493	TUBE						1						
	5128650	TUBE							1					
	5162764	TUBE (EXTENSION)									1			
	5130862	TUBE											1	
	5167747	@ HOSE (2 1/4 X2.62) (4.4240) (5155779)									1			
	9139809	CLAMP (2 1/16 -3) (12.9660)									2			
	186282	BOLT, 3/8 -16X3 1/4 (12.9001)					2	2					2	
	186283	BOLT, 3/8 -16X3 1/2 (12.9001)							2					
	103321	LOCKWASHER, 3/8 (12.9200)					2	2	2				2	

+ OBSOLETE.

@ NOT SERVICED, USE PART SHOWN IN PARENTHESES CUT TO DESIRED LENGTH.

4.5004 - BRACKET, OIL FILLER TUBE CLAMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	14	20	46	47	52	57	58	62	63	64	66	69
	5128647	BRACKET							1					
	5113863	CLAMP (2 1/4 DIA.)							1					
	179837	BOLT, 3/8 -16X3/4 (12.9001)							2					
	103321	LOCKWASHER, 3/8 (12.9200)							1					
	117062	NUT, 3/16 -16 HEX. (12.9120)							1					

4.5005 - ADAPTOR, OIL FILLER

FIG.	PART NUMBER	NAME AND DESCRIPTION	14	20	46	47	52	57	58	62	63	64	66	69
	5168175	ADAPTOR		1										
	5129516	ADAPTOR				1								
	5109689	ADAPTOR												1
	5109279	ADAPTOR ASSY. (INCLUDES ITEMS IN 4.5030)								1				
	5128208	ADAPTOR ASSY. (INCLUDES ITEMS IN 4.5030)										1		
	179838	BOLT, 3/8 -16X7/8 (12.9001)				2				5				
	186282	BOLT, 3/8 -16X3 1/4 (12.9001)		2										
	186288	BOLT, 3/8 -16X4 1/2 (12.9001)								1				
	186315	BOLT, 3/8 -24X4 1/2 (12.9001)				4								
	179857	BOLT, 7/16 -14X7/8 (12.9001)										1		
	122408	BOLT, 1/2 -13X1 (12.9001)										4		
	103321	LOCKWASHER, 3/8 (12.9200)		2		6				6				
	103322	LOCKWASHER, 7/16 (12.9200)										1		
	103323	LOCKWASHER, 1/2 (12.9200)										4		
	117049	NUT, 3/8 -24 HEX (12.9120)				4								
	5138619	WASHER				4								

4.5007 - GASKET, OIL FILLER ADAPTOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	14	20	46	47	52	57	58	62	63	64	66	69
	5168176	GASKET		1			1	1	1				1	
	5104607	GASKET (1.5060)				1				1				1
	5117061	GASKET (1.5040)										1		

4.5000A OIL FILLER

FIG.	PART NUMBER	NAME AND DESCRIPTION	14	20	46	47	52	57	58	62	63	64	66	69
		4.5010 - CAP, OIL FILLER												
6B	1543853	CAP (SNAP INCLUDES GASKET)	1	1			1	1	1				1	
6A	5117362	CAP (SQUEEZE TYPE 3 DIA.)			1					1	1	1		1
		4.5015 - GASKET, OIL FILLER CAP												
	1543857	GASKET	1	1			1	1	1				1	
		4.5020 - STRAINER, OIL FILLER												
6A	5150147	STRAINER	1	1	1		1					1		
		4.5030 - CHAIN, OIL FILLER TUBE												
6A	5113825	CHAIN (20 L.)			1	1				1				1
	5146248	HOCK, OIL FILLER CAP			2	2				2		2		2

4.6000A DIPSTICK

4.6001 - DIPSTICK

FIG.	PART NUMBER	NAME AND DESCRIPTION	346	347	348	349	351	353	355	357	361	365	368	372
7A	5162938	+ DIPSTICK (X-26.00 ,Y-1.06 ,Z-24.47)	1											
7A	5162941	DIPSTICK (X-28.00 ,Y-1.18 ,Z-25.68)		1										
7A	5109264	DIPSTICK (X-12.00 ,Y-1.12 ,Z-10.00)			1					1	1			
7A	5131934	DIPSTICK (X-59.50 ,Y-1.32 ,Z-58.00)				1								
7A	5162667	DIPSTICK (X-26.32 ,Y-1.46 ,Z-23.46)					1							
7A	5131796	DIPSTICK (X-27.00 ,Y-1.28 ,Z-25.14)						1						
7A	5109268	DIPSTICK (X-31.00 ,Y-1.44 ,Z-29.04)							1					
7A	5162926	DIPSTICK (X-15.00 ,Y-1.38 ,Z-12.47)										1		
7A	5131815	DIPSTICK (X-29.00 ,Y-1.38 ,Z-27.14)											1	
7B	5133075	DIPSTICK (X-19.25 ,Y-1.44 ,Z-17.06)												1
		+ NOT SERVICED. USE 5146680 AND INCLUDE 18SP-154.												

4.6020 - GUIDE, DIPSTICK

FIG.	PART NUMBER	NAME AND DESCRIPTION	346	347	348	349	351	353	355	357	361	365	368	372
7A	5151430	GUIDE (1 1/2 L.)	1		1		1		1		1	1	1	1
7A	5120861	GUIDE (4 5/8 L.)		1		1				1				
7A	5131786	GUIDE (3.62 L.)						1						
	137401	NUT, 1/2 TUBE (12.9460)										1	1	

4.6030 - ADAPTOR, DIPSTICK

FIG.	PART NUMBER	NAME AND DESCRIPTION	346	347	348	349	351	353	355	357	361	365	368	372
7A	5177998	ADAPTOR (22.55 DEV. L.)	1											
7A	5109799	ADAPTOR (22.12 DEV. L.)		1										
7A	5109757	ADAPTOR (6.76 DEV. L.)			1					1				
7A	5179403	ADAPTOR (55 DEV. L.)				1								
7A	5109776	ADAPTOR (21.62 DEV. L.)					1							
7A	5132815	ADAPTOR (22.06 DEV. L.)						1						
7A	5177862	ADAPTOR (21.00 DEV. L.)							1					
7A	5109752	ADAPTOR (5.34 DEV. L.)									1			
7A	5109617	ADAPTOR (8.06 DEV. L.)										1		
7A	5132989	ADAPTOR (20.20 DEV. L.)											1	
7B	5133203	ADAPTOR (14.06 DEV. L.)												1

4.6040 - CLIP, DIPSTICK

FIG.	PART NUMBER	NAME AND DESCRIPTION	346	347	348	349	351	353	355	357	361	365	368	372
	5161873	CLIP, 7/16 (7.4412)					1							
	5161875	CLIP, 7/16					1							
	5151108	CLIP, 1/2 (12.4095)	1											
	5168001	CLIP, 1/2 (12.4095)		1										1
	5170860	CLIP, 1/2				1	1							
	5153473	CLIP, 1/2							1					
	140582	CLIP, 1/2 CLOSED (12.9630)											1	
	5181325	BRACKET, CLIP (4.8242)	1											
	5155464	BRACKET, CLIP (7.1582)				1								
	5164060	BRACKET, CLIP				1								

4.7000A OIL PAN

FIG.	PART NUMBER	NAME AND DESCRIPTION	138	142	143	144	150	151	155	163	184	166	167	168
		4.7010 - PAN, OIL - UPPER (CONT'D)												
	215510	BOLT, 3/8 -16X5 3/4 (12.9001)			2			2						
	106263	WASHER, 7/16 (12.9190)			4			4	4					
	103321	LOCKWASHER, 3/8 (12.9200)			AR			AR	AR					
		* INCLUDES 3-5121182 PLUGS IN 4.7010, 2-5188498 COVERS, 4-180121 BOLTS, 4-103321 LOCKWASHERS IN 4.7120 AND 2-5170049 GASKETS IN 4.7130.												
		4.7020 - PAN, OIL - LOWER												
10B	5163616	PAN (CAST IRON) (12V)			1			1						
	5121182	PLUG, 1/4 PIPE (12.9550)			2			2						
	445751	PLUG, 1/2 PIPE (12.9550)						1						
	189697	BOLT, 5/16 -18X1 (WITH LOCKWASHER) (12.9001)			22			22						
		4.7030 - GASKET, OIL PAN TO BLOCK												
8A	5196532	GASKET SET (CAST OIL PAN)	1			1	1			1				
8A	5196533	GASKET SET (CAST OIL PAN)		1										
8A	5109915	GASKET (CAST OIL PAN)			1			1	1					
8A	5117230	GASKET (STAMPED OIL PAN)									1			
8A	5117231	GASKET (STAMPED OIL PAN)										1	1	1
		4.7040 - GASKET, LOWER OIL PAN												
	5153256	GASKET			1			1						
		4.7080 - PLUG, OIL PAN DRAIN												
		PLUGS ARE OPTIONAL WHEN MULTIPLE QUANTITIES ARE SHOWN IN THE SAME TYPE.												
8A	5138621	PLUG, 18 MM. X 1.5 MM. (4.4160)										1	1	1
8A	53688	* PLUG, 18 MM. (MAGNETIC)												1
8A	5138456	PLUG, 18 X 1.5 MM. (MAGNETIC)												1
8A	5115214	PLUG, 1/2 PIPE (12.9550)								1				
8A	5145012	PLUG, 1/2 PIPE (12.9550)	1	1	2	1	1	2				1	1	1
8A	5146891	PLUG, 1/2 PIPE (MAGNETIC)										1	1	1
8A	5146309	PLUG, 1/2 PIPE, RECESSED HEAD (MAG.)												1
8A	5142549	PLUG, 3/4 PIPE (12.9550)	1	1	2	1	3	2	1			1	1	

4.7001 - PAN, OIL

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES											
			138	142	143	144	150	151	155	163	164	166	167	168
8A	5117228	* PAN (CAST ALUMINUM) (6V)								1				
10A'	5124869	PAN (CAST IRON) (6V)	1											
8A	5117542	PAN (CAST IRON) (8V)		1										
8A	5117538	PAN (CAST IRON) (6V)				1								
8A	5147432	PAN (CAST IRON) (6V)					1							
8A	5125668	PAN (STAMPED) (6V)									1			
8A	5143772	PAN (STAMPED) (8V)										1	1	
8A	5129146	PAN (STAMPED) (8V)												1
	5121182	PLUG, 1/4 PIPE (12.9550)		2		2				2		1	1	
8A	5145012	PLUG, 1/2 PIPE (12.9550)					1							
8A	5142549	PLUG, 3/4 PIPE (12.9550)					2							
	5111798	PLUG, 1 SQ. HD. PIPE (12.9550)										2	?	
	5164294	SPACER, 13/32 X7/8 X1/8 (7.1581)										2	2	
8A	5148480	BOLT, 3/8 -16X7/8 (INCLUDES WASHER) (12.9001)									24	28	28	28
8A	186619	BOLT, 3/8 -16X1 1/8 (12.9001)								2				
8A	186679	BOLT, 3/8 -16X1 1/4 (12.9001)	4	4		4	4							
8A	9419283	BOLT, 3/8 -16X1 1/2 (W/LW)(12.9001)	20	24		24	16			20				
8A	179849	BOLT, 3/8 -16X2 1/4 (12.9001)								2				
8A	114926	BOLT, 3/8 -16X4 1/4 (12.9001)	2	2		2	2							
8A	166288	BOLT, 3/8 -16X4 1/2 (12.9001)					2							
8A	187491	BOLT, 3/8 -16X5 1/2 (12.9001)	2	2		2								
	106263	WASHER, 3/8 FLAT (12.9190)	4	4		4	4							
	103341	WASHER, 3/8 (12.9190)									2			AR
8A	103321	LOCKWASHER, 3/8 (12.9200)	AR	AR		AR	AR			AR				

* THRU 6VA-2763. EFFECTIVE WITH 6VA-2764, WHEN REPLACEMENT IS NECESSARY ON FAN TO FLYWHEEL MODELS, USE OIL PAN TYPE 164 WITH OIL DISTRIBUTION TYPE 201 AND DIPSTICK TYPE 155 ON POWER TAKE-OFF MODELS, OIL PAN TYPE 182 WITH OIL DISTRIBUTION TYPE 201 AND DIPSTICK TYPE 155 ON MARINE MODELS (RC ENGINE) USE OIL PAN TYPE 184, ON (LC ENGINE) USE OIL PAN TYPE 183 WITH OIL DISTRIBUTION TYPE 215 AND DIPSTICK TYPE 150.

4.7010 - PAN, OIL - UPPER

FIG.	PART NUMBER	NAME AND DESCRIPTION	TYPES											
			138	142	143	144	150	151	155	163	164	166	167	168
10B	5196823	* PAN ASSY. (CAST IRON) (12V)			1			1						
10B	5196822	* PAN ASSY. (CAST IRON) (12V)							1					
	5121182	PLUG, 1/4 PIPE (12.9550)			3			3	3					
	186679	BOLT, 3/8 -16X1 1/4 (12.9001)			32			4	4					
	9419283	BOLT, 3/8 -16X1 1/2 (W/LW)(12.9001)						28	28					
	114926	BOLT, 3/8 -16X4 1/4 (12.9001)			2			2	2					
	187491	BOLT, 3/8 -16X5 1/2 (12.9001)							2					

4.8000A VENTILATING SYSTEM

4.8001 - PIPE, BREATHER

FIG.	PART NUMBER	NAME AND DESCRIPTION	288	289	291	292	293	294	297	298	300	301	305	306
9B	5157033	PIPE (IN CYLINDER BLOCK) (9.34 L.)		1	1		1					1	1	1
9A	5124222	PIPE (11.78 DEV. L.)				1		1					1	
9B	5157231	PIPE (IN CYLINDER BLOCK)									1			
	5124767	PIPE (PRESSED IN CYLINDER BLOCK)	1											
9A	5109196	# TUBE (RC ENGINE)							1					
9A	5109195	# TUBE (LC ENGINE)								1				
9B	5137096	* TUBE (DEV. L. 12.46) (TC CYLINDER BLOCK)	1											
9A	5124730	@ ELBOW (REAR) (5144828 TUBE)						1						1
	5150014	PLUG (IN CYLINDER BLOCK) (1.1001)				1		2						
9A	180121	BOLT, 3/8 -16X7/8 (12.9001)							2	2				2
9A	179839	BOLT, 3/8 -16X1 (12.9001)				2		4					2	
	138242	BOLT, 3/8 -16X1 HEX. SKT. HD. (12.9027)	2											
	103341	WASHER, 3/8 FLAT (12.9190)	2											
9A	103321	LOCKWASHER, 3/8 (12.9200)	AR			AR		AR	AR	AR			AR	AR

* INCLUDE 1-5124767 PIPE.
@ NOT SERVICED REPLACE WITH P/N SHOWN IN PARENTHESES AND INCLUDE 1-5144827 FLANGE AND 1-5117636 GASKET.
# OBSOLETE.

4.8020 - GASKET, BREATHER PIPE

FIG.	PART NUMBER	NAME AND DESCRIPTION	288	289	291	292	293	294	297	298	300	301	305	306
9A	5117636	GASKET				1		2	1	1			1	1
9B	5121894	GASKET	1											

4.8040 - CLIP, BREATHER

FIG.	PART NUMBER	NAME AND DESCRIPTION	288	289	291	292	293	294	297	298	300	301	305	306
9B	5184291	CLIP (1 19/32 L.-3/8 BOLT) (8.3820)		1	1						1	1	1	1
5B	5158779	CLIP (5.5376)							1	1				
5B	5124733	CLIP (4.8180)												1
	5155464	BRACKET (7.1582)									1			
	5160425	SPACER (2.3267)			1								1	1
	186618	BOLT, 5/16 -18X5/8 (12.9001)										1		
	179816	BOLT, 5/16 -18X3/4 (12.9001)							1	1				
	181433	BOLT, 5/16 -24X5/8 (12.9001)									1			
	186318	BOLT, 3/8 -24X5 1/4 (12.9001)			1								1	1
	103320	LOCKWASHER, 5/16 (12.9200)							AR	AR	AR	AR		
	120376	NUT, 5/16 -18 HEX. (12.9120)							AR	AR	AR	AR		

4.8042 - BRACKET, BREATHER TUBE CLIP

FIG.	PART NUMBER	NAME AND DESCRIPTION	288	289	291	292	293	294	297	298	300	301	305	306
	5173022	SUPPORT (5.5379)										1		

4.8000A VENTILATING SYSTEM

FIG.	PART NUMBER	NAME AND DESCRIPTION	288	289	291	292	293	294	297	298	300	301	305	306
		4.8050 - SEPARATOR, BREATHER OIL												
9A	5109976	BODY				1		2	1	1			1	1
9A	179839	BOLT, 3/8 -16X1 (12.9001)				2		4	3	1			3	3
9A	179850	BOLT, 3/8 -16X2 3/4 (12.9001)				1		3	2	1			2	2
9A	450517	BOLT, 3/8 -16X4 3/4 (12.9001)						1	1				1	1
9A	9430221	BOLT, 3/8 -24X4 3/4 (12.9001)				2		3		3				
9A	192882	BOLT, 3/8 -24X6 1/4 (12.9001)				2		1		1				
	103321	LOCKWASHER, 3/8 (12.9200)				AR		AR	AR	AR			AR	AR
	117049	NUT, 3/8 -24 HEX. (12.9120)				4		3		4				
		4.8055 - SHELL, BREATHER												
9A	5117524	* SHELL				1		2	1	1			1	1
9A	5117523	SPACER (5/16 X3 1/8 L.)				1		2	1	1			1	1
9A	186272	BOLT, 5/16 -18X4 (12.9001)				1		2	1	1			1	1
9A	120393	WASHER, 5/16 FLAT (12.9190)				1		2	1	1			1	1
		* NOT SERVICED REPLACE WITH 1-5113734 SHELL, 1-5132041 ELEMENT AND 2-5122227 GASKETS.												
		4.8060 - FILTER UNIT, BREATHER OIL SEPARATOR												
	5130750	PAD (IN CYLINDER BLOCK) (1.1001)			2									
9A	5129604	PAD				1		2	1	1			1	1
	5130752	RETAINER (RIGHT BANK) (1.1001)			1									
	5130753	RETAINER (LEFT BANK) (1.1001)			1									
	4.807C	GASKET, BREATHER SEPARATOR												
9A	5122227	GASKET				1		2	1	1			1	1
		4.817C - PIPE, BREATHER EXTENSION												
9B	5124732	PIPE (18.70 DEV. L.)												1
9B	5108244	PIPE (29.62 DEV. L.)			1								1	1
9B	5109305	PIPE (32.34 DEV. L.)		1										
9B	5134612	PIPE (35.66 DEV. L.)					1					1		
		4.8175 - HOSE, BREATHER EXTENSION PIPE												
9B	5120011	* HOSE (1 3/4 L.)		1	1		1				1	1	1	1
9B	5163930	* HOSE (2.26 L.)												1
		* CUT TO DESIRED LENGTH												
		4.8180 - CLAMP, BREATHER EXTENSION PIPE HOSE												
9B	272859	CLAMP, 1 5/8 DIA. (12.9660)			2									2
9B	2337379	CLAMP, 1 1/2 DIA. (12.9660)		2			2				2	2	2	4

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover
2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls
3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler
4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System
5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter
6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections
7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid
8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines
9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission--Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car
10.0000	SHEET METAL
10.1000A	Engine Hood
11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base
12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits

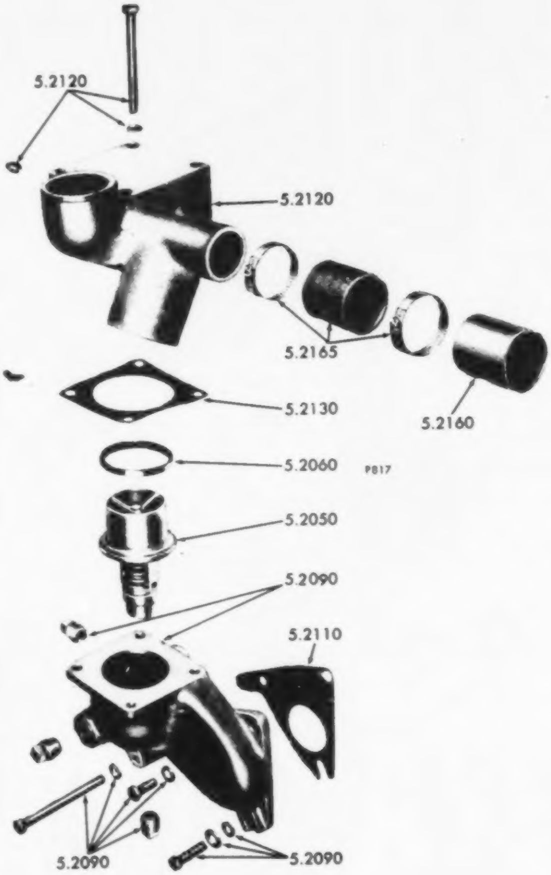

5.2120
5.2120
5.2165
5.2130
5.2160
5.2060
P817
5.2050
5.2090
5.2110
5.2090
5.2090

FIG. 3A
RIGHT BANK

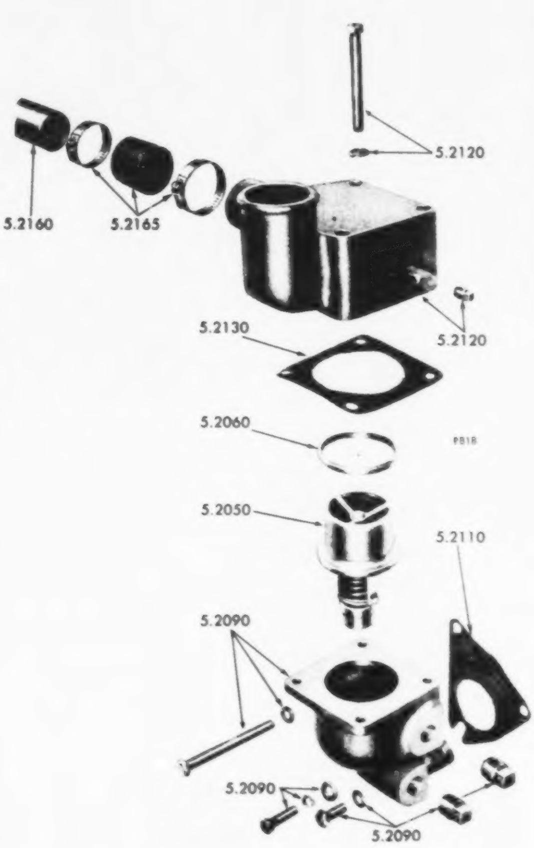

5.2120
5.2160
5.2165
5.2130
5.2120
5.2060
P818
5.2050
5.2110
5.2090
5.2090
5.2090

FIG. 3B
LEFT BANK

THERMOSTAT AND WATER BY-PASS TUBE

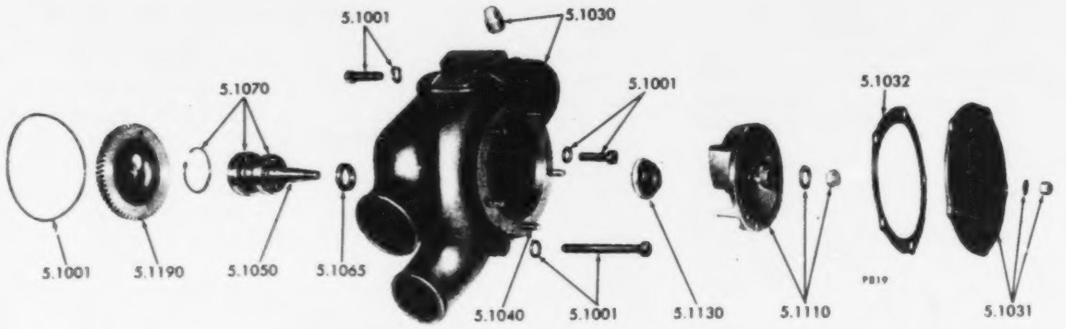

5.1001
5.1030
5.1070
5.1001
5.1032
5.1001
5.1190
5.1050
5.1065
P819
5.1040
5.1001
5.1130
5.1110
5.1031

FIG. 1A FRESH WATER PUMP (6, 8, 12V.)

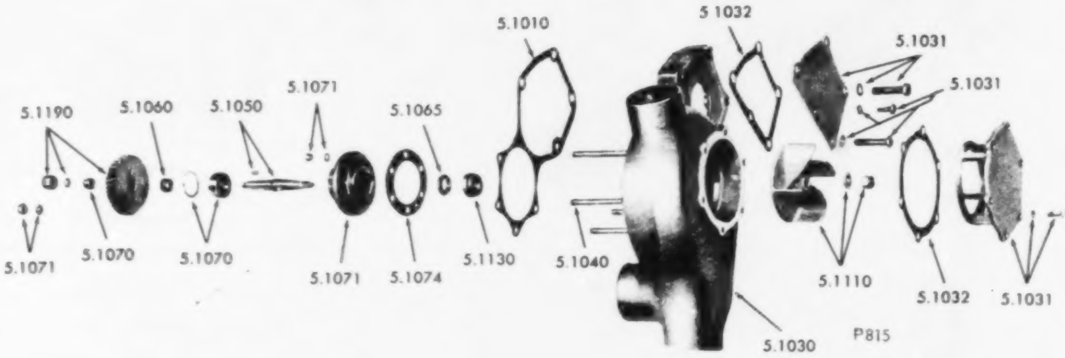

5.1010
5 1032
5.1031
5.1071
5.1031
5.1190
5.1060
5.1050
5.1065
5.1071
5.1070
5.1070
5.1130
5.1040
5.1071
5.1074
5.1110
5.1032
5.1031
5.1030
P815

FIG. 1B FRESH WATER PUMP (16V.) (FORMER DESIGN)

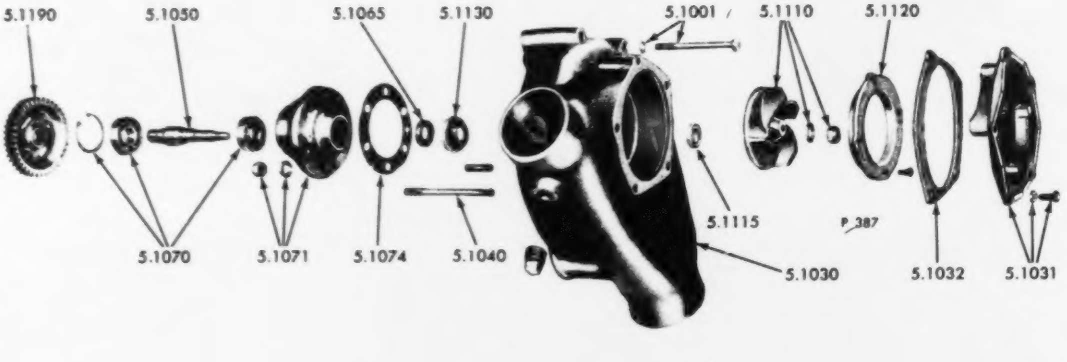

5.1190
5.1050
5.1065
5.1130
5.1001
5.1110
5.1120
5.1115
P 387
5.1070
5.1071
5.1074
5.1040
5.1030
5.1032
5.1031

FIG. 1C FRESH WATER PUMP (16V Wide Inlet)

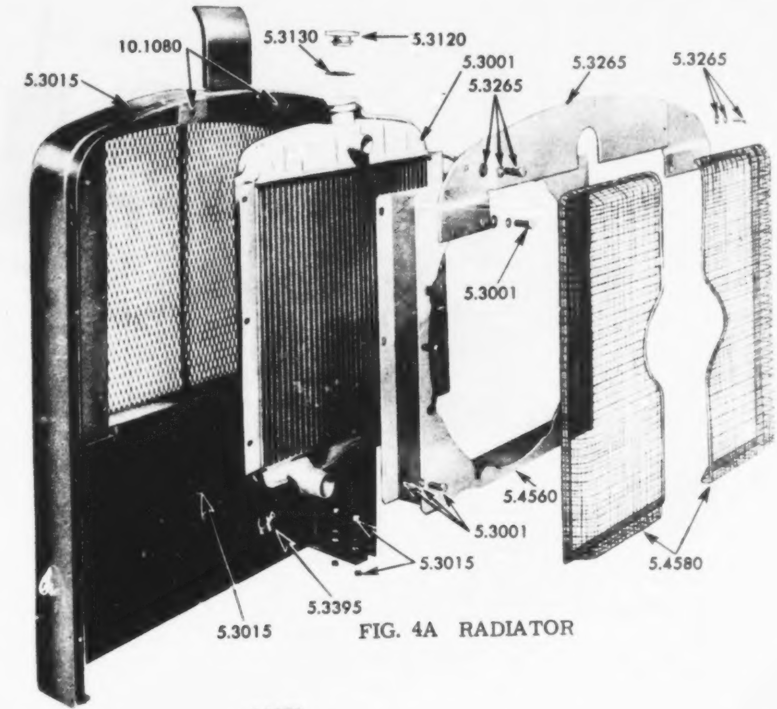
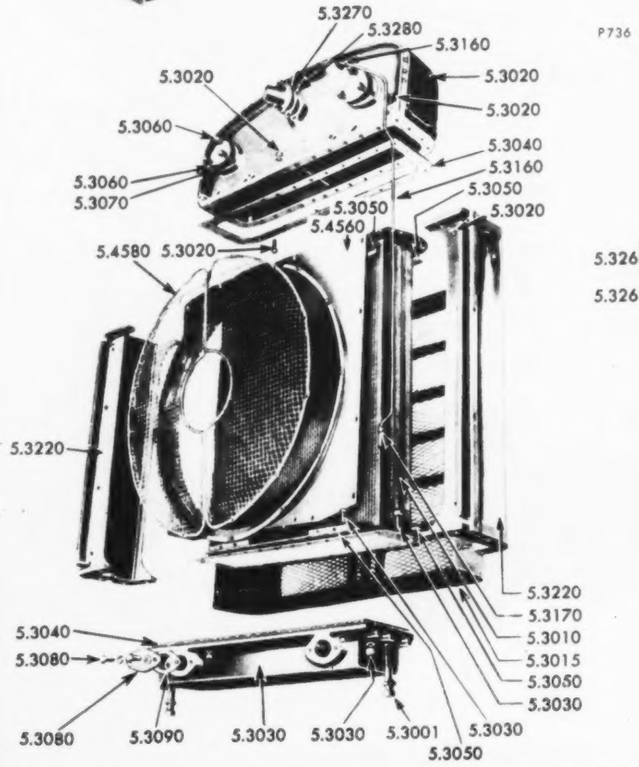
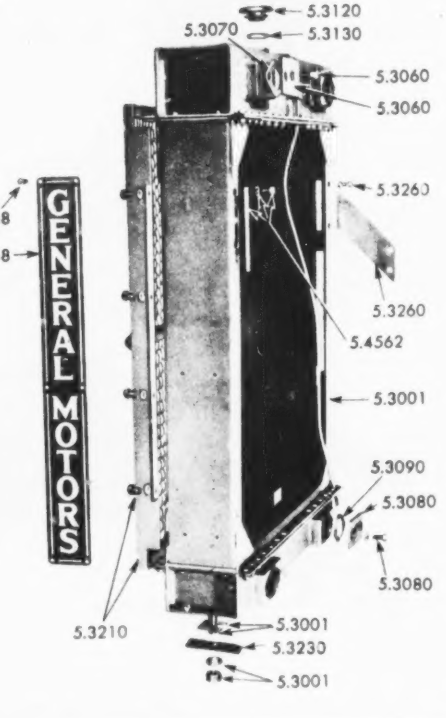

10.1080
5.3130
5.3120
5.3015
5.3001
5.3265
5.3265
5.3265
5.3001
5.4560
5.3001
5.3015
5.4580
5.3395
5.3015

FIG. 4A RADIATOR


5.3270
5.3280
5.3160
5.3020
5.3020
5.3020
5.3060
P736
5.3040
5.3160
5.3060
5.3070
5.3050
5.3050
5.4560
5.3020
5.4580
5.3020
5.3220
5.3220
5.3170
5.3010
5.3015
5.3050
5.3030
5.3040
5.3080
5.3080
5.3090
5.3030
5.3030
5.3001
5.3030
5.3050


5.3120
5.3070
5.3130
5.3060
5.3060
5.3268
5.3268
GENERAL MOTORS
5.3260
5.3260
5.4562
5.3001
5.3090
5.3080
5.3080
5.3210
5.3001
5.3230
5.3001

Figs. 4A, 4B & 4C of 5.0000

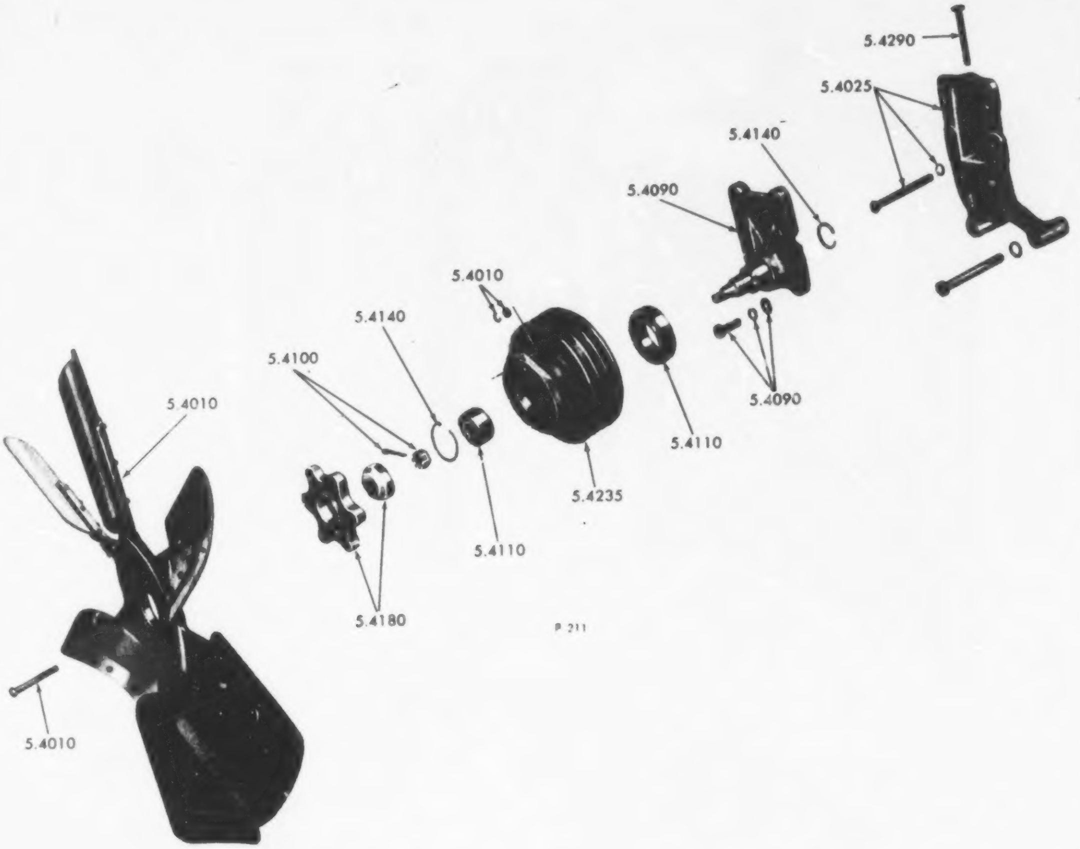

5.4290
5.4025
5.4140
5.4090
5.4010
5.4140
5.4100
5.4010
5.4090
5.4110
5.4235
5.4110
5.4180
P 211
5.4010

FIG. 6A FAN

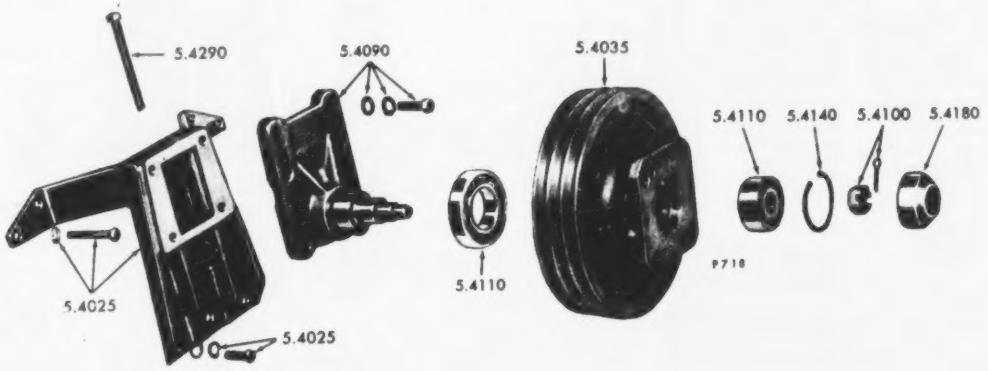

5.4290
5.4090
5.4035
5.4110
5.4140
5.4100
5.4180
P718
5.4110
5.4025
5.4025

FIG. 6B FAN (Pulley, Hub and Support) (16V)

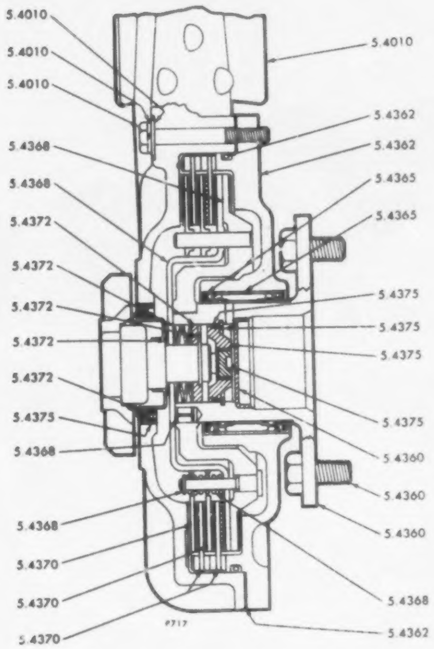

5.4010
5.4010
5.4010
5.4368
5.4368
5.4372
5.4372
5.4372
5.4372
5.4372
5.4375
5.4368
5.4368
5.4370
5.4370
5.4370
5.4010
5.4362
5.4362
5.4365
5.4365
5.4375
5.4375
5.4375
5.4375
5.4360
5.4360
5.4360
5.4368
5.4362
P717

FIG. 6C FAN (Thermo-Modulated)

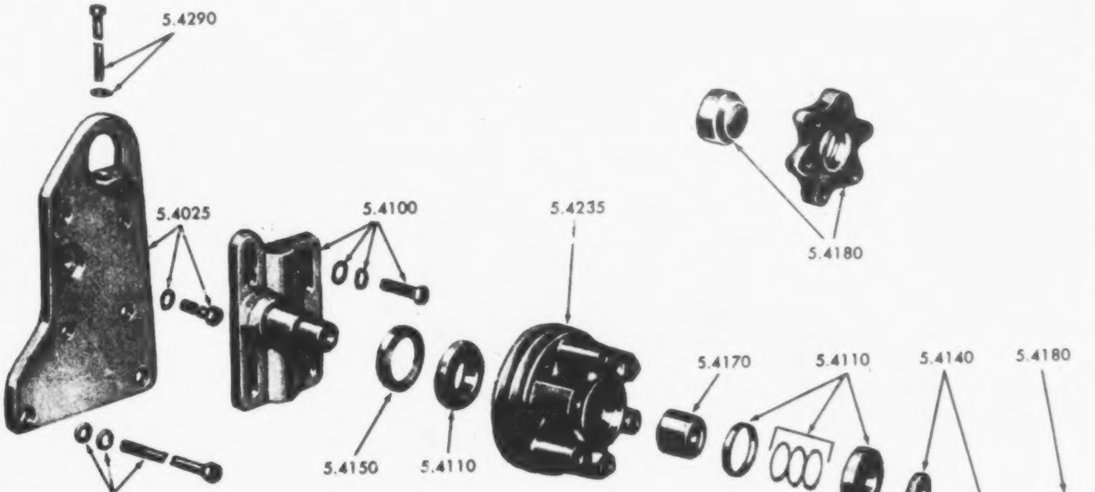

5.4290
5.4025
5.4100
5.4235
5.4180
5.4170
5.4110
5.4140
5.4180
5.4150
5.4110
5.4025
P716

FIG. 6D FAN MOUNT

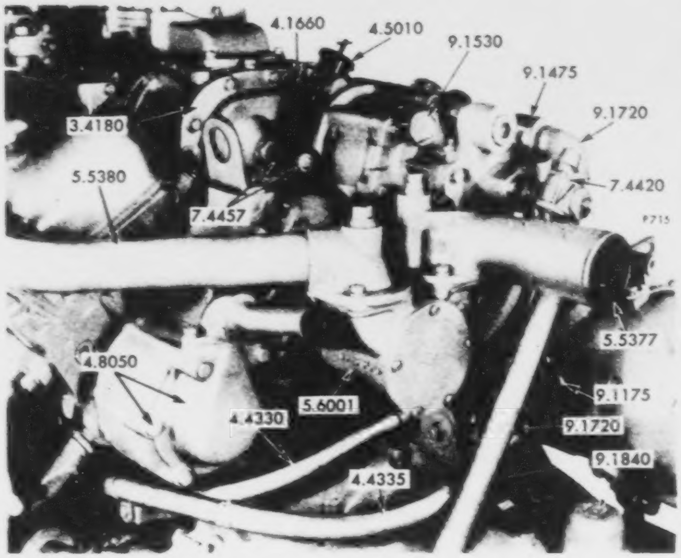

4.1660
4.5010
9.1530
9.1475
9.1720
3.4180
5.5380
7.4420
7.4457
P715
5.5377
4.8050
5.6001
9.1175
4.4330
9.1720
9.1840
4.4335

FIG. 7A WATER CONNECTIONS

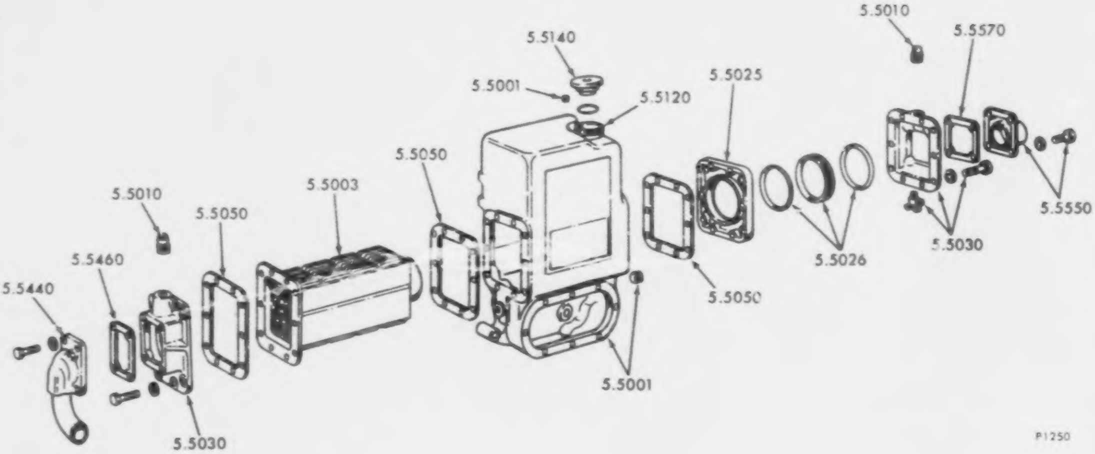

5.5010
5.5570
5.5140
5.5025
5.5001
5.5120
5.5050
5.5003
5.5010
5.5050
5.5550
5.5460
5.5026
5.5030
5.5440
5.5050
5.5001
5.5030
P1250

FIG. 7B HEAT EXCHANGER

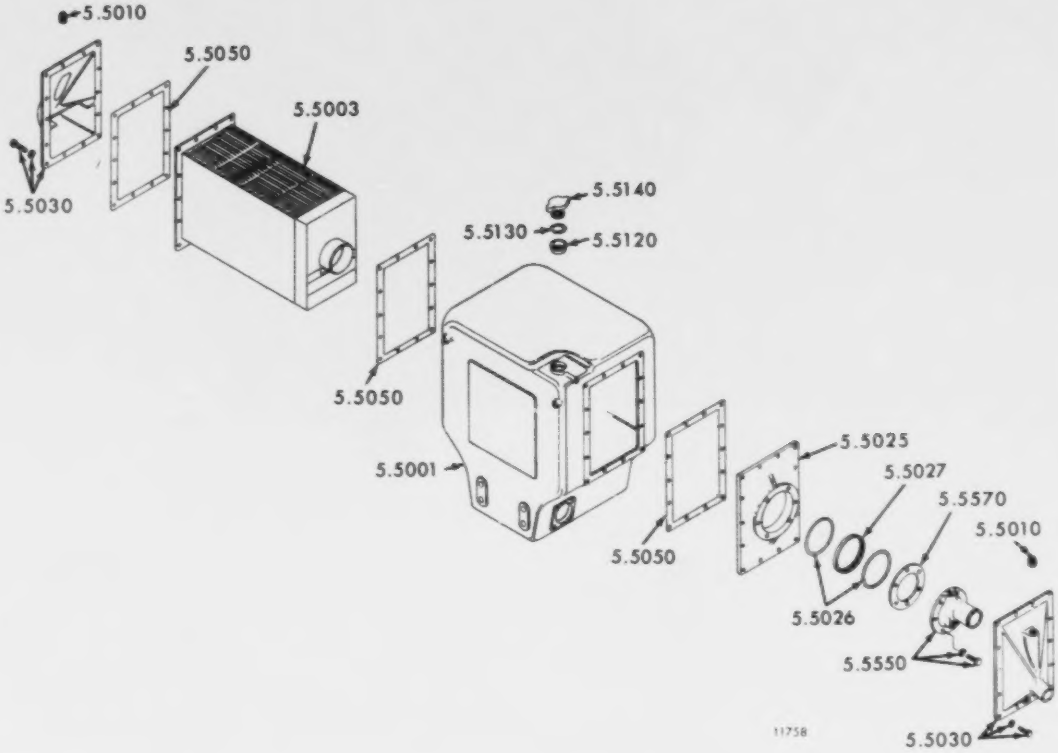

5.5010
5.5050
5.5003
5.5030
5.5140
5.5130
5.5120
5.5050
5.5001
5.5025
5.5027
5.5570
5.5010
5.5050
5.5026
5.5550
5.5030
11758

FIG. 7C HEAT EXCHANGER

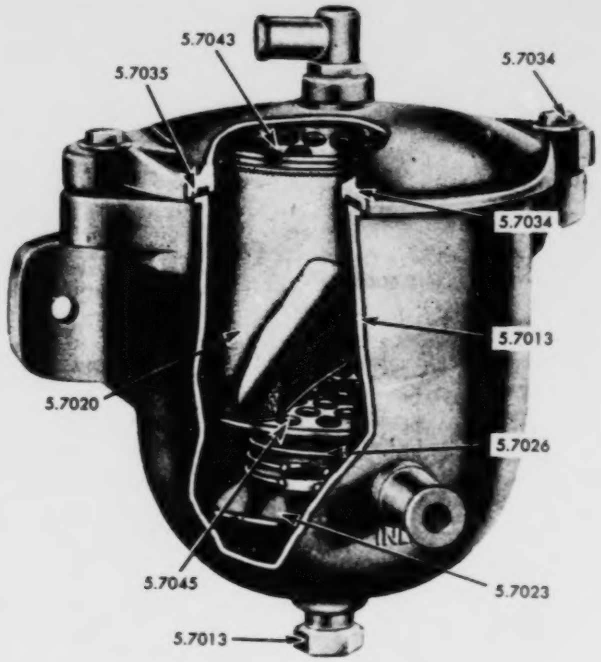

5.7043
5.7035
5.7034
5.7034
5.7013
5.7020
5.7026
5.7045
5.7023
5.7013

FIG. 9A
WATER FILTER

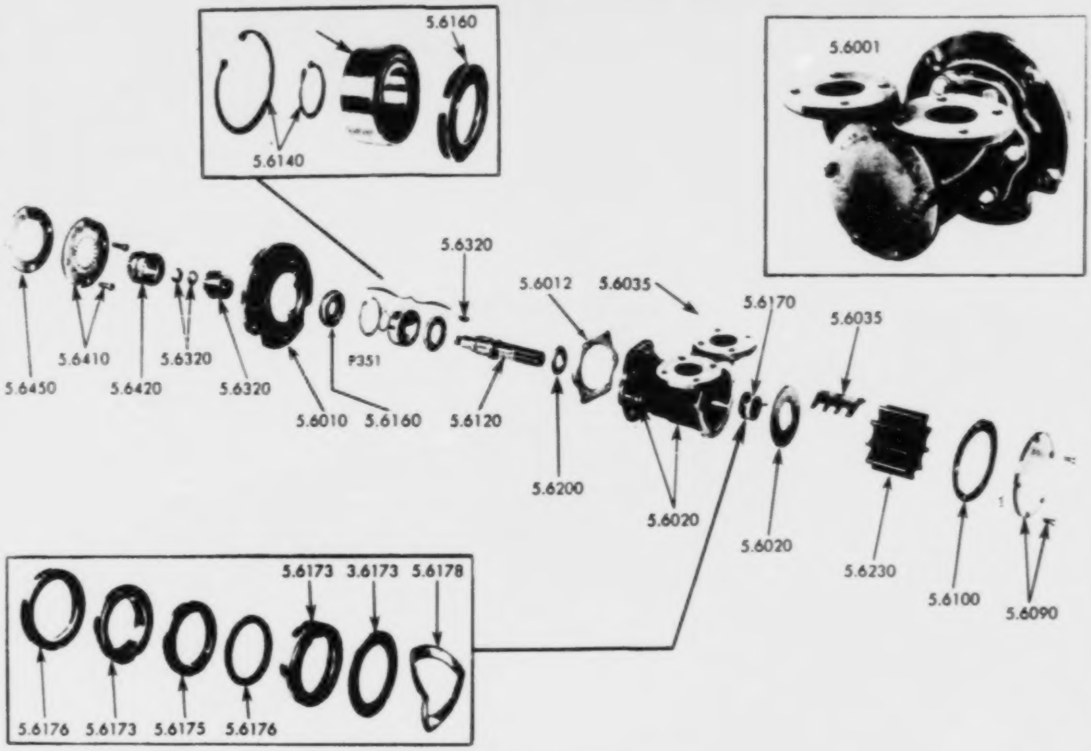

5.6160
5.6140
5.6001
5.6320
5.6012
5.6035
5.6170
5.6035
5.6450
5.6410
5.6420
5.6320
5.6320
P351
5.6010
5.6160
5.6120
5.6200
5.6020
5.6020
5.6230
5.6100
5.6090
5.6173
3.6173
5.6178
5.6176
5.6173
5.6175
5.6176

FIG. 8A RAW WATER PUMP

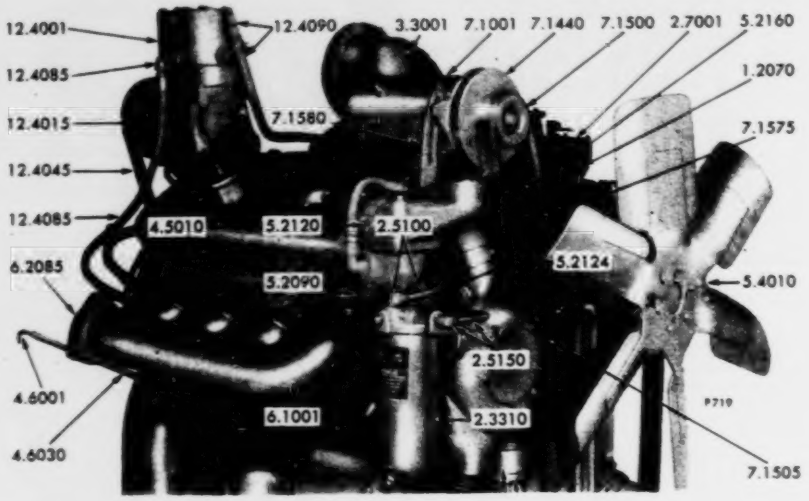
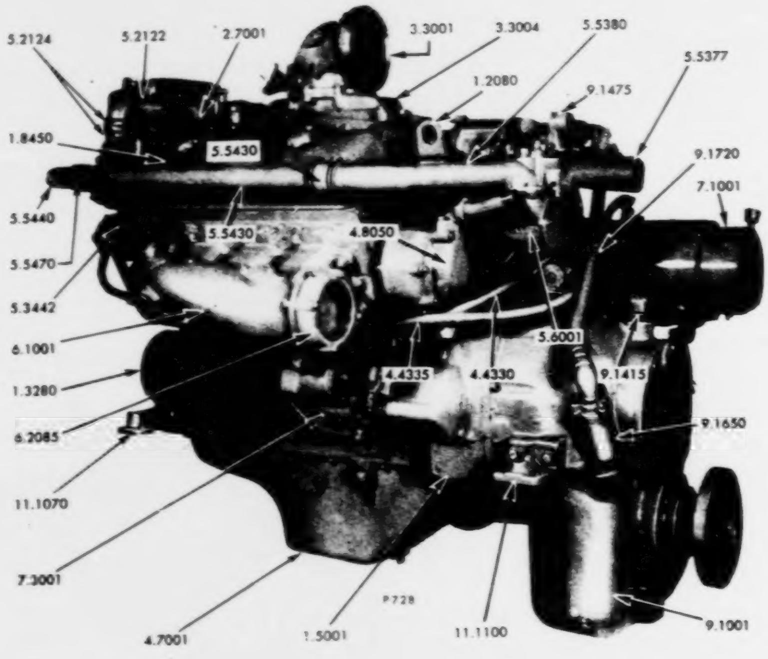

12.4001
12.4090
3.3001
7.1001
7.1440
7.1500
2.7001
5.2160
12.4085
1.2070
12.4015
7.1580
7.1575
12.4045
12.4085
4.5010
5.2120
2.5100
6.2085
5.2124
5.4010
5.2090
2.5150
4.6001
P719
6.1001
2.3310
4.6030
7.1505

FIG. 10C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5.2122
2.7001
3.3001
3.3004
5.5380
5.5377
1.2080
9.1475
1.8450
5.5430
9.1720
7.1001
5.5440
5.5430
4.8050
5.5470
5.3442
5.6001
6.1001
4.4335
4.4330
9.1415
1.3280
9.1650
6.2085
11.1070
7.3001
P728
4.7001
1.5001
11.1100
9.1001

FIG. 10D

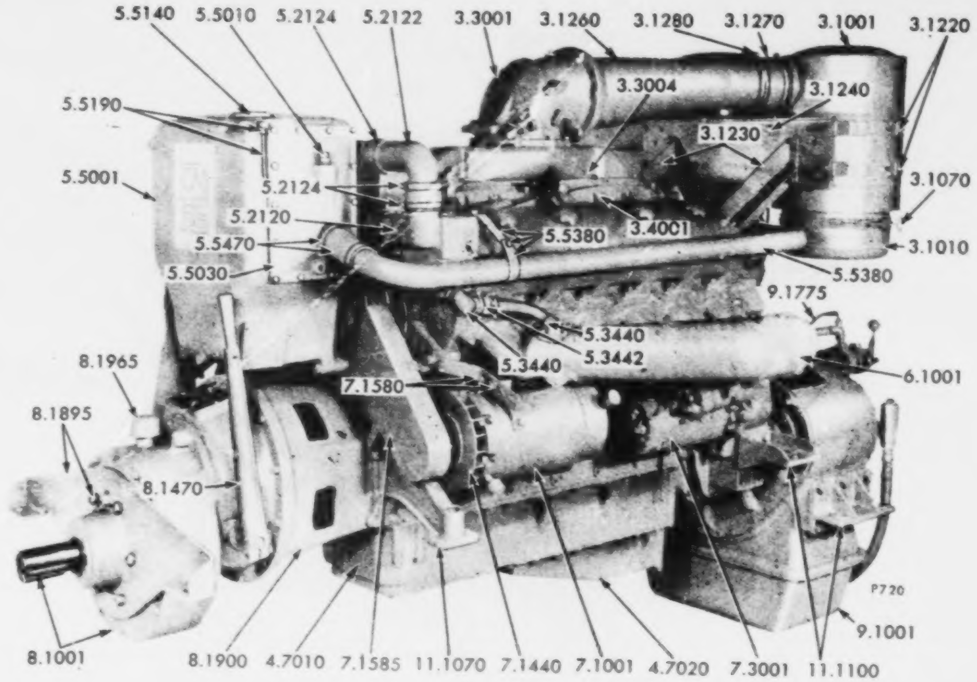

5.5140
5.5010
5.2124
5.2122
3.3001
3.1260
3.1280
3.1270
3.1001
3.1220
5.5190
3.3004
3.1240
3.1230
5.5001
5.2124
3.1070
5.2120
5.5380
3.4001
5.5470
3.1010
5.5030
5.5380
9.1775
5.3440
5.3442
8.1965
5.3440
6.1001
7.1580
8.1895
8.1470
P720
9.1001
8.1001
8.1900
4.7010
7.1585
11.1070
7.1440
7.1001
4.7020
7.3001
11.1100

FIG. 10A

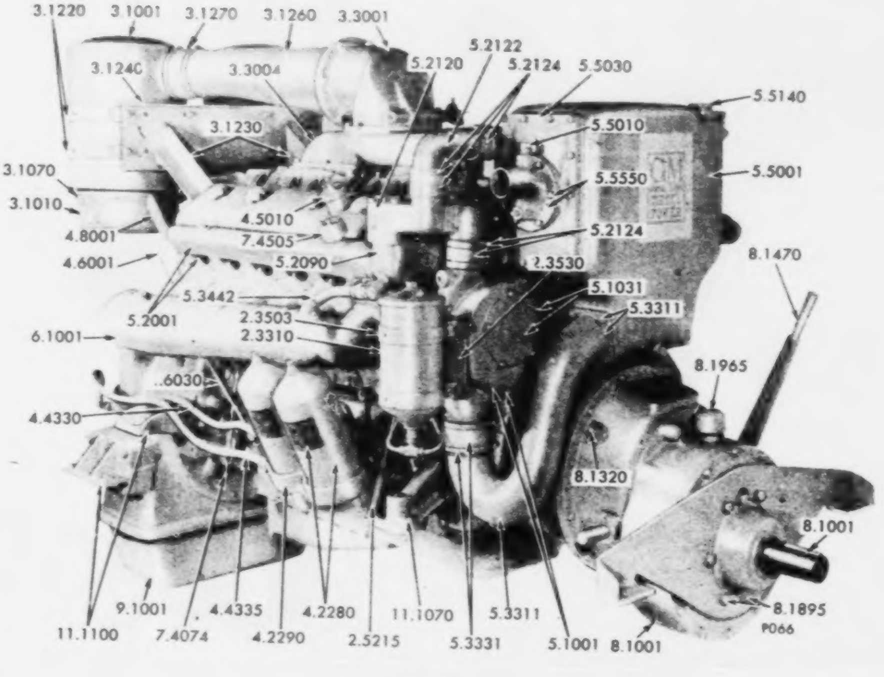

3.1220
3.1001
3.1270
3.1260
3.3001
5.2122
3.1240
3.3004
5.2120
5.2124
5.5030
5.5140
3.1230
5.5010
3.1070
5.5001
5.5550
3.1010
4.5010
4.8001
7.4505
5.2124
4.6001
5.2090
2.3530
8.1470
5.1031
5.3442
5.3311
5.2001
2.3503
2.3310
6.1001
8.1965
.6030
4.4330
8.1320
8.1001
9.1001
4.4335
4.2280
11.1070
5.3311
8.1895
P066
11.1100
7.4074
4.2290
2.5215
5.3331
5.1001
8.1001

FIG. 10B

5.1000 FRESH WATER PUMP

5.1001 - PUMP ASSY., FRESH WATER

SEE ASSEMBLY BREAKDOWN PAGES AS INDICATED BELOW.

FIG.	PART NUMBER	NAME AND DESCRIPTION	164	165	168	174	178	176	177	186
1A	5145050	* C # PUMP ASSY (PAGE A7)		1		-				1
1A	5147812	PUMP ASSY. (PAGE C1)	1			1				
1A	5145336	PUMP ASSY. (PAGE C1)			1					
1A	5149328	PUMP ASSY. (PAGE C1)					1			
1A	5146525	PUMP ASSY. (PAGE C1)						1		
1A	5147811	PUMP ASSY. (PAGE C1)							1	
	5103544	RING, SEAL (.139 X5.109 I.D.)	1	1	1	1	1	1	1	1
	5115214	PLUG, 1/2 PIPE (12.9550)	1		1		1	1		
	5142549	PLUG, 3/4 PIPE (12.9550)					1	1	3	
	128003	BUSHING, 1 X3/4 REDUCING (12.9570)							1	
	427567	BOLT, 7/16 -14X1 3/4 (12.9001)	2		1	2		2	2	
	454939	BOLT, 7/16 -14X4 (12.9001)	1			1	1	1	1	
	190909	BOLT, 7/16 -14X5 (12.9001)		1	1					1
	187425	BOLT, 7/16 -14X5 1/4 (12.9001)		1	1					1
	103342	WASHER, 7/16 FLAT (12.9190)	1	1	1	1	1	1	1	1
	103322	LOCKWASHER, 7/16 (12.9200)	3	3	3	3	3	3	3	3

* USES WATER PUMP GEAR 5146254.
& REQUIRES GEAR SHOWN IN 1.7200 AND WEIGHTS IN 1.7140 FOR UNITS THRU 6VA 2908, 8VA-566 AND 12VA-457.
# INCLUDE 1- 5111798 PLUG

FIG.	PART NUMBER	NAME AND DESCRIPTION	164	165	168	174	178	176	177	186
	179862	BOLT, 7/16" - 14 x 1 1/2" (12.9001)					2			

5.1002 - RECONDITIONING KIT, FRESH WATER PUMP

A RECONDITIONING KIT INCLUDES SEAL RING IN 5.1001, BEARINGS AND LOCKRING IN 5.1070, IMPELLER AND NUT IN 5.1110, AND ITEMS IN 5.1032, 5.1050, 5.1065 AND 5.1130. A CARTRIDGE KIT INCLUDES ITEMS IN 5.1050, 5.1065, 5.1070, 5.1071, 5.1130 AND 5.1190.

FIG.	PART NUMBER	NAME AND DESCRIPTION	164	165	168	174	178	176	177	186
	5197508	KIT, RECONDITIONING					AR			
	5197509	KIT, RECONDITIONING	AR			AR		AR	AR	
	5198576	KIT, RECONDITIONING		AR	AR					AR

5.1115 - REPLACEMENT KIT, FRESH WATER PUMP SEAL

INCLUDES CERAMIC INSERT AND ADHESIVE.

FIG.	PART NUMBER	NAME AND DESCRIPTION	164	165	168	174	178	176	177	186
	5197279	REPLACEMENT KIT, IMPELLER INSERT	AR	AR	AR	AR	AR	AR	AR	AR

5.1000 FRESH WATER PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		5.10C1 - PUMP ASSY., FRESH WATER														
	5144124	PUMP ASSY.	1													
	5131798	PUMP ASSY.		1												
1A	5145336	PUMP ASSY.			1											
	5145050	PUMP ASSY.				1										
1A	5149328	PUMP ASSY.					1									
1A	5147811	PUMP ASSY.						1								
1A	5147812	PUMP ASSY.							1							
1A	5146529	PUMP ASSY.								1						
		5.1030 - BODY, FRESH WATER PUMP														
	5145266	BODY	1		1											
1A	5135455	BODY		1			1			1						
	5145089	BODY				1										
1A	5142406	BODY						1								
1A	5130701	BODY							1							
		5.1031 - COVER, FRESH WATER PUMP BODY														
1A	5117961	COVER (WATER PUMP)	1		1	1										
1A	5117950	COVER (WATER PUMP)		1			1	1	1	1						
	5131685	BOLT, 5/16 -18X3/4 (NYLON INSERT) (12.9001)		5			5	5	5	5						
		5.1032 - GASKET, FRESH WATER PUMP BODY COVER														
1A	5117975	GASKET		1			1	1	1	1						
1A	5117976	GASKET	1		1	1										
		5.1040 - STUD, FRESH WATER PUMP BODY														
	5131685	BOLT, 5/16 -18X3/4	4		4	4										
		5.1050 - SHAFT ASSY., FRESH WATER PUMP														
1A,C	5123150	SHAFT	1	1	1	1	1	1	1	1						
		5.1065 - SEAL, FRESH WATER PUMP SHAFT BEARING OIL														
1A	5117983	SEAL	1	1	1	1	1	1	1	1						

5.1000 FRESH WATER PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		5.1070 - BEARING, FRESH WATER PUMP														
1A,C	903204	BEARING (INNER) (N.C.3204X1A)	1	1	1	1	1	1	1	1						
1A,C	903304	BEARING (N.D. 3304) (OUTER) (8.3736)	1	1	1	1	1	1	1	1						
1A	274746	LOCKRING (OUTER BEARING) (5.4235) . .	1	1	1	1	1	1	1	1						
		5.1110 - IMPELLER, FRESH WATER PUMP														
1A	5123185	+ IMPELLER ASSY.	1			1										
1A	5123622	+ IMPELLER ASSY.		1			1									
1A	5123183	+ IMPELLER ASSY.						1	1	1						
1A	5131600	IMPELLER ASSY.			1											
1A	120395	WASHER, 7/16 FLAT (12.9190)	1	1	1	1	1	1	1	1						
1A	5117972	NUT, 7/16 -20 HEX. LOCK . . . . + INCLUDES INSERT WHICH IS AVAILABLE IN KIT 5197279.	1	1	1	1	1	1	1	1						
		5.1130 - SEAL, FRESH WATER PUMP.														
1A	5130959	SEAL	1	1	1	1	1	1	1	1						
		5.1190 - GEAR, FRESH WATER PUMP DRIVE														
1A	5146254	GEAR (42 TEETH)	1		1	1	1									

5.2000B THERMOSTAT

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
	5.2050 -	THERMOSTAT												
3A,B	5104832	THERMOSTAT (170 DEG. OPENING TEMPERATURE)	2	4	4	2	2	4	4	2	2	4	4	4
	5.2060 -	SEAL, THERMOSTAT												
3A,B	5132155	SEAL	2	4	4	2	2	4	4	2	2	4	4	4
	5.2090 -	HOUSING, THERMOSTAT												
3A	5109652	HOUSING (RIGHT BANK)	1			1	1			1	1			
3B	5117546	HOUSING (LEFT BANK)	1			1	1			1	1			
3A	5135149	HOUSING (RIGHT BANK)											1	1
3B	5127692	HOUSING (LEFT BANK)											1	1
3A	5122628	HOUSING ASSY. (RIGHT BANK)		1	1			1	1			1		
3B	5122377	HOUSING ASSY. (LEFT BANK)		1	1			1	1			1		
	5122612	RETAINER, VENT SEAL (IN CYLINDER HEAD)		1	1			1	1			1		
	5179232	RING, SEAL (.424 I.D.) (2.4225)		1	1			1	1			1		
	5146607	BUSHING, 1/2 PIPE X 1 PIPE	1			1	1			1	1			
3A,B	444692	PLUG, 1/4 PIPE (12.9550)											3	3
3A,B	5115214	PLUG, 1/2 PIPE (12.9550)	4			AR	4			AR	4			
	5142549	PLUG, 3/4 PIPE (12.9550)	1	2	2		2	2	2		2	2	2	2
	103647	DRAINCOCK, 1/4 (12.9510)		1	1							1		
3A,B	179839	BOLT, 3/8 -16X1 (12.9001)		2	2	2	2	2	2	2	2	2		
3A,B	186622	BOLT, 3/8 -16X1 1/4 (12.9001)											2	2
3A,B	186628	BOLT, 3/8 -16X1 1/2 (12.9001)	2	2	2	2	2	2	2	2	2	2		
3A,B	151249	BOLT, 3/8 -16X3 3/4 (12.9001)				1	1			1	1			
3A,B	455537	BOLT, 3/8 -16X4 (12.9001)				1	1			1	1			
3A,B	454933	BOLT, 7/16 -14X1 1/8 (12.9001)		2	2			2	2			2	1	1
3A,B	193221	BOLT, 7/16 -14X1 1/4 (12.9001)											2	2
3A,B	450501	BOLT, 7/16 -14X2 3/4 (12.9001)											1	1
3A,B	5152148	WASHER, 3/8 COPPER (2.4050)	4	2	2	4	4	2	2	4	4	2	2	2
3A,B	103341	WASHER, 3/8 FLAT (12.9190)	2	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
3A,B	5125106	WASHER, 7/16 (2.4030)		2	2			2	2			2	2	2
3A,B	103342	WASHER, 7/16 FLAT (12.9190)	6	AR				AR	AR			AR		
3A,B	103321	LOCKWASHER, 3/8 (12.9200)		AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR
3A,B	103322	LOCKWASHER, 7/16 (12.9200)		AR				AR	AR			AR		
	5104154	BOLT, 3/8" – 16 x 1" (W/SEAL PATCH)	2											
	5104157	BOLT, 3/8" – 16 x 3.75" (W/SEAL PATCH)	1											
	5104158	BOLT, 3/8" – 16 x 4" (W/SEAL PATCH)	1											
	5.2110 -	GASKET, THERMOSTAT HOUSING												
3A	5117993	GASKET (RIGHT BANK)	1			1	1			1	1			
3B	5117993	GASKET (LEFT BANK)	1			1	1			1	1			
3A	5123716	GASKET (LEFT BANK)		1	1			1	1			1		
3B	5123715	GASKET (RIGHT BANK)		1	1			1	1			1		

5.2000B THERMOSTAT

5.2120 - COVER, THERMOSTAT HOUSING

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
3A	5127600	COVER (RIGHT BANK)	1			1	1			1	1			
3B	5127599	COVER (LEFT BANK)	1			1	1			1	1			
3A	5128268	COVER (RIGHT BANK)		1	1			1	1			1		
3B	5128269	COVER (LEFT BANK)		1	1			1	1			1		
3B	5127412	COVER (LEFT BANK)											1	1
3A	5127411	COVER (RIGHT BANK)											1	1
3A,B	5145009	PLUG, 1/8 PIPE (12.9550)	2	2	2	2	2	2	2	2	2	2		
3A,B	5145C13	PLUG, 3/8 PIPE (12.9550)				1	1							
	5142549	PLUG, 3/4 PIPE (12.9550)	1	1	1			1	1			1		
	5128234	PIN (JIGGLE)	2	2	2	2	2	2	2	2	2	2	2	2
3A,B	100141	BOLT, 3/8 -16X3 1/2 (12.9001)	8	8	12	8	8	12	12	8	8	12		
3A,B	191249	BOLT, 3/8 -16X3 3/4 (12.9001)											12	12
3A,B	103321	LOCKWASHER, 3/8 (12.9200)	8	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR

5.2122 - ELBOW, THERMOSTAT HOUSING COVER OUTLET

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
	5122440	* ELBOW (TEE) (KEEL COOLING)		1										
	5122423	ELBOW (KEEL COOLING)		1										
10A	5122423	ELBOW (HEAT EXCHANGER COOLING)			2							2		
	5122459	ELBOW (LEFT BANK) (KEEL COOLING)				1								
	5122410	ELBOW (RIGHT BANK) (KEEL COOLING)				1								
10D	5122410	ELBOW (HEAT EXCHANGER COOLING)					2			2				
	5129911	ELBOW (KEEL COOLING) (RIGHT BANK)												1
	5129857	ELBOW (KEEL COOLING) (LEFT BANK)												1
		* NOT SERVICED. USE 5132552 ELBOW AND INCLUDE 1- 444692 PLUG.												

5.2124 - HOSE, THERMOSTAT HOUSING COVER OUTLET

ELBOW

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
	5127299	* HOSE (2 1/4 I.D.X2 1/4 L.) (5199779)				4	4			4				
	5199780	* HOSE (2 3/8 I.D.X2.12 L.)	1								1			
	5140552	* HOSE (2 3/8 I.D.X2.12 L.) (5199780)								1				
10A,B	5177273	a HOSE (2 1/2 I.D.X2 1/4 L.)		4	4							4		
10B	5123708	* HOSE (2 3/4 I.D.X2 1/4 L.)(5112537)		1	1			1	1			1		
10B	5137839	* HOSE (3 I.D.X3 L.) (6.1147) (5114853)	.											4
	5119659	* HOSE (3 1/2 I.D.X2 3/4 L.) (5.3331) (5108390)											1	1
10D	9139809	CLAMP (2 1/16 -3 DIA.) (12.9660)	2	8	8	8	8			8		8		
	5188036	CLAMP (2 9/16 -3 1/2 DIA.)(12.9660)		2	2			2	2			2		8
	9139813	CLAMP (4) (3.5400)											2	2

* CUT TO DESIRED LENGTH

5.2124 - HOSE, THERMOSTAT HOUSING COVER OUTLET (CONT'D)

@ NOT SERVICED. USE 5137848 HOSE AND INCLUDE 2-5135647 CLAMPS.

5.2126 - MANIFOLD, HEAT EXCHANGER WATER (BETWEEN OUTLET ELBOWS)

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
	5122457	MANIFOLD (KEEL COOLING UNITS)		1										
*	5122458	MANIFOLD (HEAT EXCHANGER UNITS)			1							1		
	5122503	MANIFOLD (KEEL COOLING UNITS)				1								
*	5122504	MANIFOLD (HEAT EXCHANGER UNITS)					1			1				
	5129864	MANIFOLD (KEEL COOLING UNITS)												1
	103647	DRAINCOCK, 1/4 (12.9510)												1
	186679	BOLT, 3/8 -16X1 1/4 (12.9001)		6	6	4	4			4		6		6
	103321	LOCKWASHER, 3/8 (12.9200)		6	6	4	4			4		6		6

* FIG. 10B OF 4.0000.

5.2128 - GASKET, HEAT EXCHANGER WATER MANIFOLD

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
	5122454	GASKET		3	3							3		3
	5124029	GASKET				1	1			1				

5.2130 - GASKET, THERMOSTAT HOUSING COVER

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
3A,B	5117786	GASKET	2			2	2			2	2			
	5175989	GASKET		2	2			2	2			2	2	2

5.2135 - TUBE, THERMOSTAT HOUSING VENT

FIG.	PART NUMBER	NAME AND DESCRIPTION	74	75	76	77	78	79	92	93	94	96	97	99
	5121333	* TUBE (RIGHT BANK) (DEV.L. 13.88)											1	1
	5120686	* TUBE (LEFT BANK) (DEV.L. 12.30)											1	1
	137407	CONNECTOR, 3/8 INV. FL. TUBE (12.9460)											1	1

* NOT SERVICED USE 1-5133301 TUBE (RB), 1-5133244 TUBE (LB) AND INCLUDE 2-137423 ELBOW, 2-5177936 CONNECTOR, 2-5179937 NUT AND 2-5179938 SEAL RING.

5.2000C WATER BY-PASS TUBE

5.2160 - TUBE, WATER BY-PASS

FIG.	PART NUMBER	NAME AND DESCRIPTION	136	140	141	142	175	180	189	193	197	198	223	224
	5100120	TUBE						1						
	5130036	# TUBE (CAST IRON)								1	1	1		
3A,B	5130285	TUBE (13.10 L.)							1					
	5135000	TUBE (13 1/8 L.)												1
3A,B	5117989	TUBE (13 1/8 L.)	1											
3A,B	5146357	TUBE (DEV. L. 13 3/8)				1								
3A,B	5122398	TUBE (DEV. L. 16 5/8)		1										
3A,B	5123500	TUBE (DEV. L. 16 5/8)			1									
	5135390	TUBE (17.00 L.)											1	
3A,B	5127633	TUBE (18.00 L.)					1							
	5130521	SPACER (5/8 O.D.X54)									1	1		
	5130444	SPACER (1 O.D.X2.02)										2		
	103647	DRAINCOCK, 1/4 (12.9510)			1				1					
	5121182	PLUG, 1/4 PIPE (12.9550)			1	1			1					
	5145011	PLUG, 3/8 PIPE (12.9550)									1	1	1	
	5145012	PLUG, 1/2 PIPE (12.9550)												1
	142314	BOLT, 3/8 -24X7 3/4 (12.9001)								1	1	1		
	179871	BOLT, 7/16 -14X3 1/4 (12.9001)								2	2	2	2	
	103321	LOCKWASHER, 3/8 (12.9200)								1	1	1		
	103322	LOCKWASHER, 7/16 (12.9200)								2	2	2	2	
	117049	NUT, 3/8 -24 HEX. (12.9120)								1	1	1		

NOT SERVICED REPLACE WITH 1-5135390 TUBE AND 1-186315 BOLT WITH FRONT MOUNTED GENERATOR OR 1-5126655 BOLT WITH NO FRONT MOUNTED GENERATOR.

5.2165 - HOSE, WATER BY-PASS TUBE

FIG.	PART NUMBER	NAME AND DESCRIPTION	136	140	141	142	175	180	189	193	197	198	223	224
3A,B	5199776	@ HOSE (1 3/4 I.D.X2 L.)	2						2					2
3A,B	3222709	@ HOSE (1 3/4 I.D.X2 3/4 L.) (5199776)				2								
3A,B	5173450	@ HOSE (2 I.D.X2 1/2 L.) (5199778)		2	2									
3A,B	5136039	@ HOSE (2 1/2 I.D.X2.74 L.) (5199781)					2			2	2	2	2	
3A,B	5108615	@ HOSE (2 3/8 I.D.X1.62 L.) (5199780)						1						
3A,B	5140552	@ HOSE (2 3/8 I.D.X2 1/8 L.) (5199780) (5.2124)						1						
3A,B	5186841	CLAMP (1 9/16 -2 1/2 RANGE) (12.9660)	4	4		4			4					4
3A,B	9139809	CLAMP (2 1/16 -3 RANGE) (12.9660)			4			4						
	5135647	CLAMP (2 3/4 -3 1/16 RANGE) (12.9660)					4			4	4	4	4	

@ CUT TO DESIRED LENGTH

5.2190 - CLIP, WATER BY-PASS TUBE

FIG.	PART NUMBER	NAME AND DESCRIPTION	136	140	141	142	175	180	189	193	197	198	223	224
	5108249	CLIP (2 3/8)						1						
	5109066	BRACKET						1						
	186629	BOLT, 5/16 -18X1 (12.9001)						1						

5.4000A FAN

5.4010 - BLADE, FAN

FIG	PART NUMBER	NAME AND DESCRIPTION	614	618	619	622	623	624	628	630	631	633	650
	NPN	BLADE (CUSTOMER FURNISHED)		1									
	5128508	BLADE (24 -6 BLADE, SUCTION)			1	1							
	5177766	BLADE (26 -6 BLADE, SUCTION)									1		
6A	5177871	BLADE (28 -6 BLADE, SUCTION)	1										
	5122913	BLADE (34 -8 BLADE, BLOWER)						1					
	5122912	BLADE (34 -8 BLADE, SUCTION)											1
	179819	BOLT, 5/16 -18X1 1/8 (12.9001)			6								
	100015	BOLT, 5/16 -24X1 1/4 (12.9001)				6							
6A	454151	BOLT, 5/16 -24X1 1/2 (12.9001)						6					
6A	446093	BOLT, 5/16 -24X2 3/8 (12.9001)	6									6	6
	100019	BOLT, 5/16 -24X2 1/2 (12.9001)									6		
	181350	BOLT, 5/16 -24X2 3/4 (12.9001)								6			
	181351	BOLT, 5/16 -24X3 (12.9001)					8						
6A	103320	LOCKWASHER, 5/16 (12.9200)	6		6	6	8	6		6	6		6
6A	114493	NUT, 5/16 -24 HEX. (12.9120)	6			6	8	6		6	6		6

5.4015 - PULLEY AND HUB ASSY., FAN

FOR COMPONENTS SEE ASSEMBLY
BREAKDOWN PAGES AS INDICATED.

FIG	PART NUMBER	NAME AND DESCRIPTION	614	618	619	622	623	624	628	630	631	633	650
	5103860	PULLEY AND HUB ASSY. (PAGE 81)					1	1		1	1	1	1
	5129509	PULLEY AND HUB ASSY. (PAGE 81)	1			1							
	5132188 *	PULLEY AND HUB ASSY. (PAGE 81) (5101001)			1								

* NOT SERVICED, COMPONENTS ARE
AVAILABLE, FOR COMPLETE REPLACEMENT
USE PART NUMBER SHOWN IN PARENTHESES

5.4025 - SUPPORT, FAN MOUNTING

FIG	PART NUMBER	NAME AND DESCRIPTION	614	618	619	622	623	624	628	630	631	633	650	
6A	5103079	SUPPORT		1		1	1		1	1	1	1	1	1
6A	5122264	SUPPORT	1					1						
6A	5131940 *	SUPPORT			1									
6A	5126729	SPACER	1				1			1				
	5109919	SPACER			2									
	9409053	BOLT, 1/2 -13X1 1/2 (12.9001)					4							
	442734	BOLT, 1/2 -13X4 (12.9001)			1									
6A	187201	BOLT, 1/2 -13X4 3/4 (12.9001)	1	1		1	1	1		1		1	1	1
	187152	BOLT, 1/2 -13X5 (12.9001)								1				
6A	271563	BOLT, 5/8 -11X2 1/4 (12.9001)		1			1						1	
6A	271574	BOLT, 5/8 -11X5 (12.9001)	2	2	2	2	2	2	2	2	2	2	2	
	5131978	WASHER, .53 X1 (1.5001)					4							
	103345	WASHER, 5/8 FLAT (12.9190)								AR				
6A,B	103323	LOCKWASHER, 1/2 (12.9200)	AR	AR	AR	AR	1	AR	AR	AR	AR	AR		
6A	103325	LOCKWASHER, 5/8 (12.9200)	AR	A	AR	AR	3	AR	AR	AR	AR	AR	AR	

* NOT SERVICED. USE 5145024 AND

5.4000A FAN

FIG.	PART NUMBER	NAME AND DESCRIPTION	614	618	619	622	623	624	628	630	631	633	650
	5.4025 -	SUPPORT, FAN MOUNTING (CONT'D)											
		INCLUDE 4-427564 AND 1-5108434.											
	5.4090 -	BRACKET, FAN SHAFT											
		(FOR CUSTOMER FURNISHED BRACKET)											
	NPN	BRACKET ASSY. (CUSTOMER FURNISHED) .		1									
6A,B	186725	BOLT, 1/2 -13X1 1/2 (12.9001) . . .		2									
	103343	WASHER, 1/2 FLAT (12.9190)		AR									
	103323	LOCKWASHER, 1/2 (12.9200)		AR									
	5.4100 -	SHAFT, FAN											
		(FOR CUSTOMER FURNISHED BRACKET)											
6A,B	103385	PIN, 1/8 X1 1/4 COTTER (12.9250) . .		1									
6A,B	122797	NUT, 5/8 -18 HEX. SLOTTED (12.9130) .		1									
	5.4110 -	BEARING, FAN SHAFT											
		(FOR CUSTOMER FURNISHED BRACKET)											
6A,B	907278	BEARING (INNER) (N.D. ZS7509LR18) . .		1									
6A,B	908002	BEARING (OUTER) (N.D. 55694L1C) . . . (5.4332)		1									
	5.4140 -	RETAINER, FAN SHAFT BEARING											
		(FOR CUSTOMER FURNISHED BRACKET)											
6A	5188194	RING, SNAP (1.350 I.D.)		1									
6A,B	274746	RING, LOCK (5.4235)		1									
	5.4180 -	CAP AND SPACER ASSY., FAN HUB											
		A CAP AND SPACER ASSY. INCLUDES SPACER WHICH IS NOT SOLD SEPARATELY AND SPACER CAP IN 5.4180.											
6A	5103718	SPACER, .80 THICK					1					1	1
	5103676	CAP AND SPACER ASSY. (SPACER .50 W.)					1						
6A,B	5172852	CAP (SPACER)	1							1	1	1	1
6A,B	5144798	CAP (PULLEY)		1									

5.4290 - SCREW, FAN BRACKET ADJUSTING

FIG.	PART NUMBER	NAME AND DESCRIPTION	614	618	619	622	623	624	628	630	631	633	650
6A	5132028	BOLT (5/16 -18X2.50)			1								
6A	5122282	BOLT (1/2 -13X3 1/2)	1					1					
6A,B	5124203	BOLT (1/2 -13X5)		1		1	1		1	1	1	1	1
	103340	WASHER, 5/16 FLAT (12.9190)			1								

5.4000A FAN

FIG.	PART NUMBER	NAME AND DESCRIPTION	COLUMN D
5.4015 - PULLEY AND HUB ASSY., FAN			
	5104352	PULLEY ASSY.	
	5103568	PULLEY ASSY.	
	5103966	PULLEY ASSY.	
	5103860	PULLEY ASSY.	1
	5103968	PULLEY ASSY.	
	5103884	PULLEY ASSY.	
	5103969	PULLEY ASSY.	
	9409053	BOLT, 1/2 -13X1 1/2 (12.9001)	
	5131978	WASHER, .53 THICK (1.5001)	
5.4100 - SHAFT, FAN			
	5103609	SHAFT	
	5103868	SHAFT	1
	5103886	SHAFT	
5.4110 - BEARING, FAN SHAFT			
	954373	BEARING, BALL	
	7455625	BEARING	
	7455596	BEARING	2
	903206	BEARING, BALL	1
	191758	FITTING, 1/8 (12.9540)	1
5.4140 - RETAINER, FAN SHAFT BEARING			
	9418788	RING, SNAP	
	9422755	RING, SNAP	1
	5103624	WASHER	
	5104317	WASHER	1
	9409129	BOLT, 1/2 -20X1 3/4 (12.9001)	
	9409060	BOLT, 1/2 -20X1 1/2 (12.9001)	1
5.4150 - SEAL, FAN SHAFT			
	5103623	SEAL, OIL	
	5103951	SEAL, OIL	1
5.4180 - CAP AND SPACER ASSY., FAN HUB			
	5103625	CAP (PULLEY)	
	5100890	CAP (PULLEY)	1
	5103882	CAP (PULLEY)	
	455322	FITTING, 1/8 (12.9540)	1

..FIG..	PART ..NUMBER..	........NAME AND DESCRIPTION........	..........COLUMN.......... D
		5.4235 - HUB, FAN	
	5104290	PULLEY (HUB) (3 GROOVE, 9.12 DIA.) .	
	5103617	PULLEY (HUB) (3 GROOVE, 12.00 DIA.) .	
	5103863	PULLEY (HUB) (3 GROOVE, 7.28 DIA.) .	
	5103862	PULLEY (HUB) (3 GROOVE, 9.12 DIA.) .	1
	5103865	PULLEY (HUB) (3 GROOVE, 9.75 DIA.) .	
	5103877	PULLEY (HUB) (3 GROOVE, 9.12 DIA.) .	
	5103866	PULLEY (HUB) (3 GROOVE, 12.00 DIA.) .	

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover

2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls

3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler

4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System

5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter

6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections

7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid

8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines

9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission—Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car

10.0000	SHEET METAL
10.1000A	Engine Hood

11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base

12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits

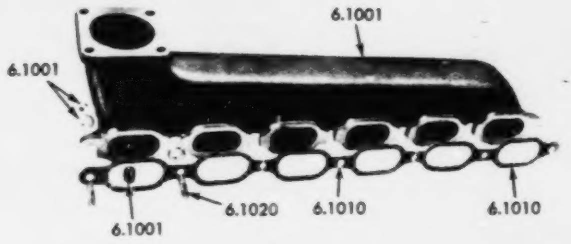

6.1001
6.1001
6.1001
6.1020
6.1010
6.1010

FIG. 1A EXHAUST MANIFOLD (END OUTLET)

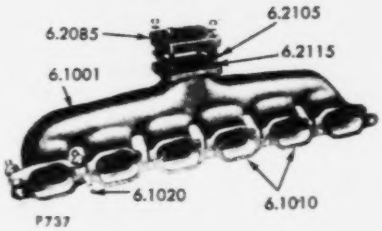

6.2105
6.2085
6.2115
6.1001
6.1020
6.1010
P737

FIG. 1B EXHAUST MANIFOLD (CENTER OUTLET)

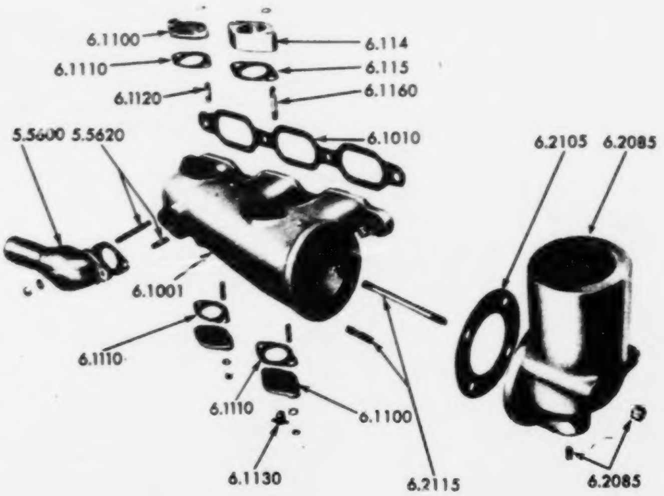

6.1100
6.114
6.1110
6.115
6.1120
6.1160
5.5600 5.5620
6.1010
6.2105 6.2085
6.1001
6.1110
6.1110
6.1100
6.1130
6.2115
6.2085

FIG. 1C EXHAUST MANIFOLD (WATER COOLED)

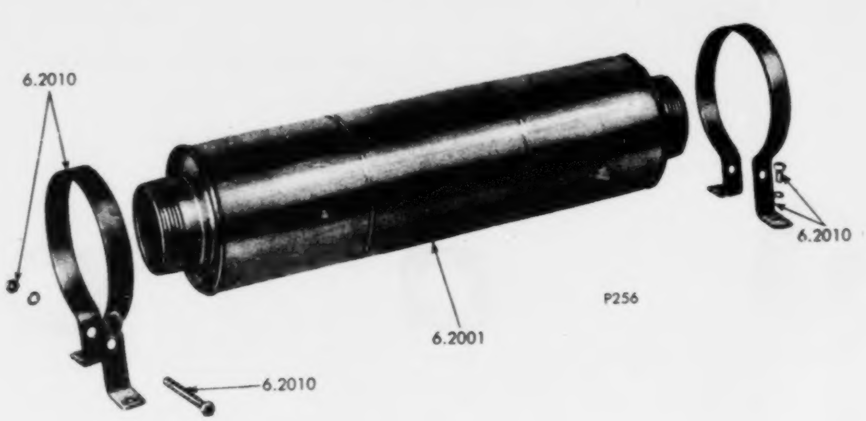

6.2010
6.2010
6.2001
P256
6.2010

FIG. 2A EXHAUST MUFFLER ASSY. (Low Degree Silencing)

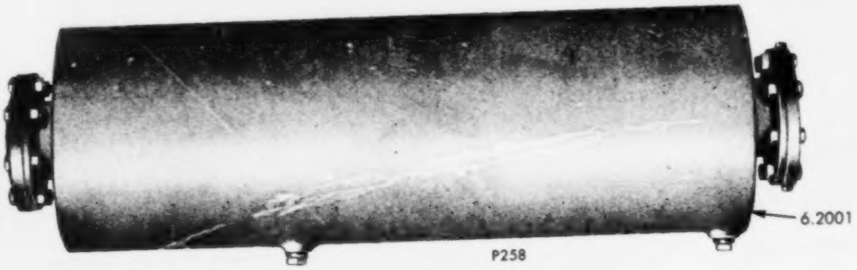


FIG. 2C EXHAUST MUFFLER ASSY. (High Degree Silencing)

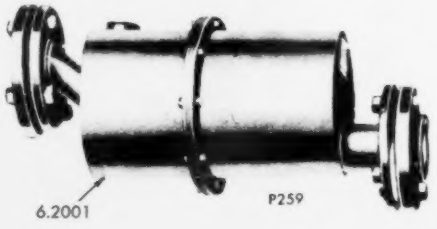
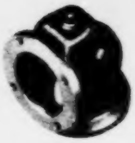
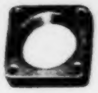


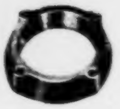
FIG. 2D EXHAUST MUFFLER ASSY. (Wet Type)



6.2085

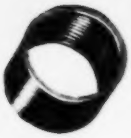


6.2085



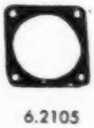
6.2085

6.2080—6.2090

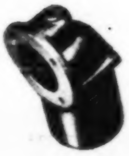


6.2090

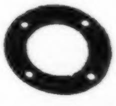
6.2095



6.2105



6.2085



6.2105

EXHAUST MUFFLER CONNECTION

Fig. 3C of 6.0000

6.1000A EXHAUST MANIFOLD

FIG.	PART NUMBER	NAME AND DESCRIPTION	210	213	219	220	221	222	225	227	229	231	232	235
	6.1001	- MANIFOLD, EXHAUST												
	5130761	* MANIFOLD (SIDE OUTLET) (MARMAN FLANGE) (LEFT BANK) (6V)	1											
1A	5135974	& MANIFOLD (END OUTLET) (16V)		2										
1A	5135975	= MANIFOLD (END OUTLET) (16V)		2										
1A	5129022	MANIFOLD (END OUTLET, MARMAN FLANGE) (RIGHT BANK) (8V)			1									
1A	5126993	MANIFOLD (END OUTLET, MARMAN FLANGE) (LEFT BANK) (8V)			1									
1A	5130720	+ MANIFOLD (VERTICAL END OUTLET) (R. BANK) (8V)				1								
1A	5130718	MANIFOLD (VERTICAL END OUTLET) (L. BANK) (8V)				1								
1A	5130306	@ MANIFOLD (END OUTLET) (RIGHT BANK) (8V)					1						1	
1A	5130308	MANIFOLD (END OUTLET) (LEFT BANK) (8V)					1			1			1	
	5124304	MANIFOLD (SIDE OUTLET, MARMAN FLANGE) (6V)						2						
1A	5162689	MANIFOLD (CENTER VERTICAL OUTLET) (RIGHT BANK) (6V)							1					
1A	5162690	MANIFOLD (CENTER VERTICAL OUTLET) (LEFT BANK) (6V)							1		2			
1A	5130305	MANIFOLD (END OUTLET) (RIGHT BANK) (8V)								1				
1A	5162690	MANIFOLD (CENTER VERTICAL OUTLET) (6V)												
1A	5129648	MANIFOLD (END OUTLET, MARMAN FLANGE) (LEFT BANK) (6V)										1		
1A	5124305	MANIFOLD (SIDE OUTLET, MARMAN FLANGE) (RIGHT BANK) (6V)	1									1		
1B	5108427	MANIFOLD (CENTER VERTICAL OUTLET) (8-16V)											2	
1B	5114950	MANIFOLD (CENTER VERTICAL OUTLET) (8V)												2
	189060	BUSHING, 1/4 X1/4 RED. (12.9570)					2			2			2	
	2011306	ELBOW, 1/4 -45 DEG. STREET (12.9590)											2	
	103647	DRAINCOCK, 1/4 (12.9510)					2			2			2	
	5102735	CRAB	4	8	4	4	4	4	4	4	4	4	4	
	113175	PLUG, 1/8 PIPE (BRASS) (12.9550)							2		2		2	
	5101377	BOLT, 3/8 -16X1 (12.9001)							12		12			
1A	5188273	WASHER, DISHED (1 1/4 O.D.)	4	12	6	6	6	4	4	6		4	4	10
1A	5174746	NUT, 7/16 -20 LOCK HEX. (12.9120)		20		10				10				10
1A	127855	NUT, 7/16 -20 HEX. (12.9120)	8		10		10	8	8		8	8	10	
	5104439	WASHER									4			

* OBSOLETE.
& LEFT BANK REAR, RIGHT BANK FRONT.
= RIGHT BANK REAR, LEFT BANK FRONT.
+ NOT SERVICED, REPLACE WITH 5130719, INCLUDE (1) 5121098 COVER, (1) 5113412 GASKET, (2) 186618

6.1000A EXHAUST MANIFOLD

6.1001 - MANIFOLD, EXHAUST (CONT'D)

BOLTS AND (2) 103320 LOCKWASHERS.
@ NOT SERVICED, USE 5130305 PLUS (1) 5121098, (1) 5113412, (2) 186618 AND (2) 103320.
NOT SERVICED USE 5129646 AND INCLUDE (1) 5121098 PLATE, (1) 5113412, (2) 186618 BOLTS AND (2) 103320 LOCKWASHERS.

6.1010 - GASKET, EXHAUST MANIFOLD

FIG.	PART NUMBER	NAME AND DESCRIPTION	210	213	219	220	221	222	225	227	229	231	232	235
1A	5120224	GASKET		8	4									
1A	5150196	GASKET				4	4			4			4	
1A	5122866	GASKET	2					2	2		2	2		2

6.1020 - STUD, EXHAUST MANIFOLD

FIG.	PART NUMBER	NAME AND DESCRIPTION	210	213	219	220	221	222	225	227	229	231	232	235
1A	5112899	STUD (2 3/32 L.)	8	16	10	10	10	8	8	10	8	8	10	10
1A	5150197	STUD (2 1/8 L.)		4										

6.2000A EXHAUST MUFFLER AND/OR CONNECTIONS

FIG	PART NUMBER		NAME AND DESCRIPTION	232	233	234	242	248	250	256	264	267	269	279	282
			6.2001 - MUFFLER ASSY., EXHAUST												
2A	5124596		MUFFLER (LOW DEGREE SILENCING)						2						
2C	5162724	*	MUFFLER (MODERATE SILENCING)										2		
	218873		BUSHING, 3 1/2 X3 REDUCING (12.9570)						2						
	218885		BUSHING, 4 X3 REDUCING (12.9570)										2		
			* NO LONGER AVAILABLE FOR SERVICE.												
			6.2085 - FLANGE, EXHAUST												
18,3	5108632		FLANGE (3)			2									
18,3	5108351		FLANGE (3 1/2)	2											
18,3	5108921		FLANGE (4)		2		1								
18,3	5167173		FLANGE (4)				1								
			6.2095 - CONNECTION, FLEXIBLE EXHAUST												
18,3	3290853		CONNECTION (3 PIPE THREAD 18 L.)							4					
18,3	5130534		CONNECTION (3 1/2 PIPE THREAD 18.12 L.)									2			
	218873		BUSHING, 3 1/2 X3 REDUCING (12.9570)							4					
			6.2105 - GASKET, EXHAUST OUTLET												
18,3	5145238		GASKET	2											
18,3	5108989		GASKET		2		2								
18,3	5108377		GASKET			2									
18,3	5100147		GASKET								4				
3	5148029		GASKET												2
			6.2115 - STUD, EXHAUST OUTLET												
18	5109158		STUD (3/8 X2 1/2)	8		8									
18	5109160		STUD (1/2 X2 1/2)		8										
	103321		LOCKWASHER, 3/8 (12.9200)	AR		8									
	103322		LOCKWASHER, 7/16 (12.9200)				4								
	103323		LOCKWASHER, 1/2 (12.9200)		AR		AR								
	114547		NUT, 3/8 -24 HEX. (12.9120)	8		8	8								
	122013		NUT, 1/2 -20 HEX. (12.9120)		8		8								
			6.2120 - ADAPTOR, EXHAUST OUTLET												
	5108415	@	ADAPTOR					1							
	5130895		ADAPTOR											1	
	5109283	*	ADAPTOR ASSY. (INCLUDES STUDS)												2

GROUP NOMENCLATURE

1.0000	ENGINE (less major assemblies)
1.1000	Cylinder Block
1.1000A	Air Box Drains
1.2000	Cylinder Head
1.2000A	Engine Lifter Bracket
1.3000	Crankshaft, Oil Seals and stabilizers
1.3000A	Crankshaft Front Cover
1.3000B	Vibration Damper
1.3000C	Crankshaft Pulley
1.3000D	Crankshaft Pulley Belt
1.4000A	Flywheel
1.5000A	Flywheel Housing
1.5000B	Flywheel Housing Adaptor
1.6000	Connecting Rod and Piston
1.7000	Camshaft and Gear Train
1.7000A	Balance Weight Cover
1.7000B	Accessory Drive
1.8000	Valve and Injector Operating Mechanism
1.8000A	Rocker Cover

2.0000	FUEL SYSTEM
2.1000A	Fuel Injector
2.2000	Fuel Pump
2.2000A	Fuel Pump Drain
2.3000A	Fuel Filter
2.4000	Fuel Manifold and/or Connections
2.4000A	Dual Fuel System
2.5000A	Fuel Lines and Fuel Cooler
2.6000A	Fuel Tank
2.7000A	Mechanical Governor
2.8000A	Hydraulic Governor
2.9000	Injector Controls
2.9000A	Throttle Controls

3.0000	AIR SYSTEM
3.1000A	Air Cleaner and/or Adaptor
3.2000A	Air Silencer
3.3000A	Air Inlet Housing
3.4000	Blower
3.4000A	Blower Drive Shaft
3.4000B	Blower End Plate Cover
3.5000A	Turbocharger and Intercooler

4.0000	LUBRICATING SYSTEM
4.1000A	Oil Pump
4.1000B	Oil Distribution System
4.1000C	Oil Pressure Regulator
4.2000A	Oil Filter
4.3000A	Oil Filter Lines
4.4000A	Oil Cooler and Marine Gear Lines
4.5000A	Oil Filler
4.6000A	Dipstick
4.7000A	Oil Pan
4.8000A	Ventilating System

5.0000	COOLING SYSTEM
5.1000	Fresh Water Pump
5.1000A	Fresh Water Pump Cover
5.2000A	Water Outlet Manifold and/or Elbow
5.2000B	Thermostat
5.2000C	Water By-pass Tube
5.3000A	Radiator
5.3000B	Water Connections
5.4000A	Fan
5.4000B	Fan Shroud
5.5000A	Heat Exchanger or Keel Cooling
5.6000A	Raw Water Pump
5.7000A	Water Filter

6.0000	EXHAUST SYSTEM
6.1000A	Exhaust Manifold
6.2000A	Exhaust Muffler and/or Connections

7.0000	ELECTRICAL—INSTRUMENTS
7.1000A	Battery Charging Generator
7.2000A	Battery Cables
7.2000B	Automatic Starting
7.3000A	Starting Motor
7.4000A	Instruments
7.4000B	Tachometer Drive
7.4000C	Shut-off, Alarm and O.S. Governor
7.5000A	Power Generator
7.6000A	Control Cabinet
7.7000A	Wiring Harness
7.8000A	Air Heater
7.10000A	Hydraulic Governor Solenoid

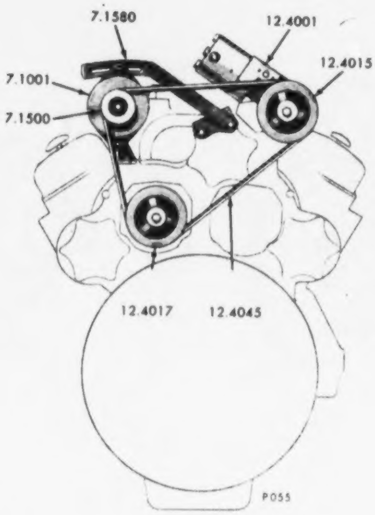
8.0000	POWER TAKE-OFF
8.1000A	Power Take-off and/or Clutch
8.3000A	Torque Converter
8.3000B	Transmission Lines

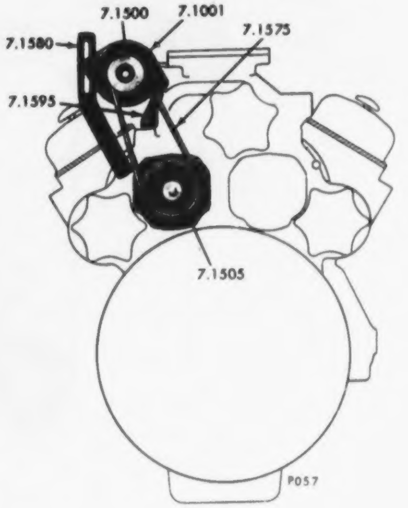
9.0000	TRANSMISSION AND PROPULSION
9.1000A	Hydraulic Marine Gear
9.2000A	Reverse and Reduction Gear (mechanical)
9.3000A	Power Transfer Gear
9.4000	Transmission—Highway
9.7000	Transmission—Off-highway
9.9000	Transmission—Rail Car

10.0000	SHEET METAL
10.1000A	Engine Hood

11.0000	ENGINE MOUNTING
11.1000A	Engine Mounting and Base

12.0000	MISCELLANEOUS
12.2000A	Bilge Pump
12.3000A	Vacuum Pump
12.4000A	Air Compressor
12.5000A	Hydraulic Pump
12.6000A	Gasoline Starter
12.6000B	Air Starter
12.6000C	Cold Weather Starting Aid
12.6000D	Hydraulic Starter
12.6000E	Hydraulic Starter Accessories
12.8000A	Supplies
12.8000B	Fabrication Material
12.8000C	Service Kits


7.1580
12.4001
12.4015
7.1001
7.1500
12.4017
12.4045
P055


7.1500
7.1001
7.1575
7.1580
7.1595
7.1505
P057

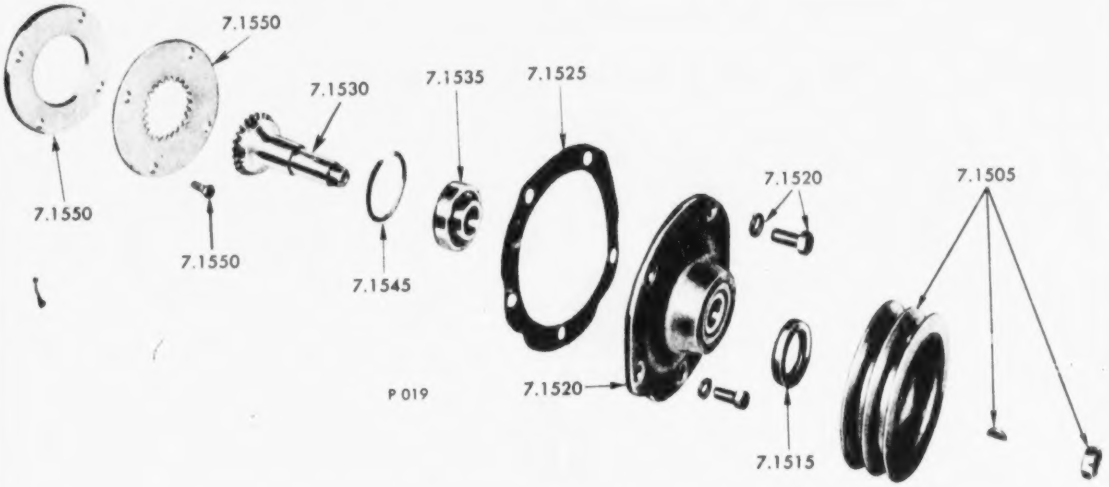

7.1550
7.1530
7.1535
7.1525
7.1520
7.1505
7.1550
7.1550
7.1545
P 019
7.1520
7.1515

FIG. 1C HIGH MOUNTED CAMSHAFT DRIVEN (Triangle Drive)

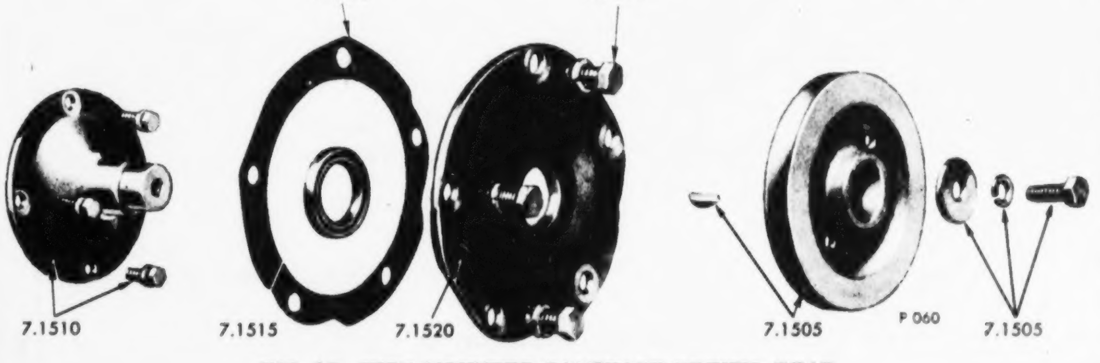

7.1525
7.1520
7.1510
7.1515
7.1520
7.1505
P 060
7.1505

FIG. 1D HIGH MOUNTED CAMSHAFT DRIVEN: REAR

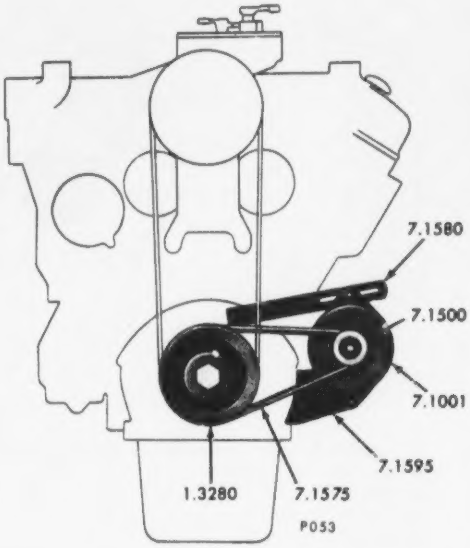

7.1580
7.1500
7.1001
7.1595
1.3280
7.1575
P053

FIG. 1A LOW MOUNTED CRANKSHAFT DRIVEN

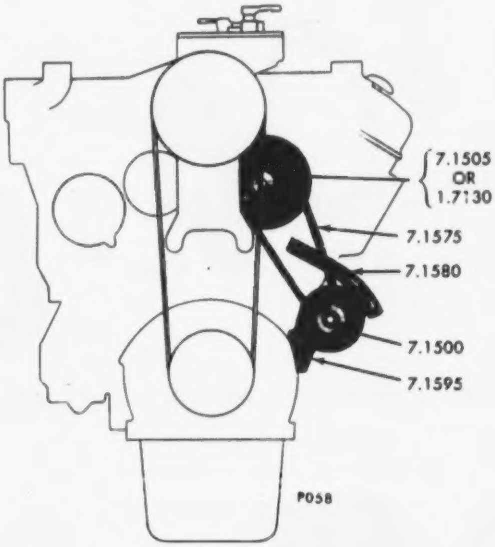

7.1505
OR
1.7130
7.1575
7.1580
7.1500
7.1595
P058

FIG. 1B LOW MOUNTED CAMSHAFT DRIVEN, FRONT

V-,1

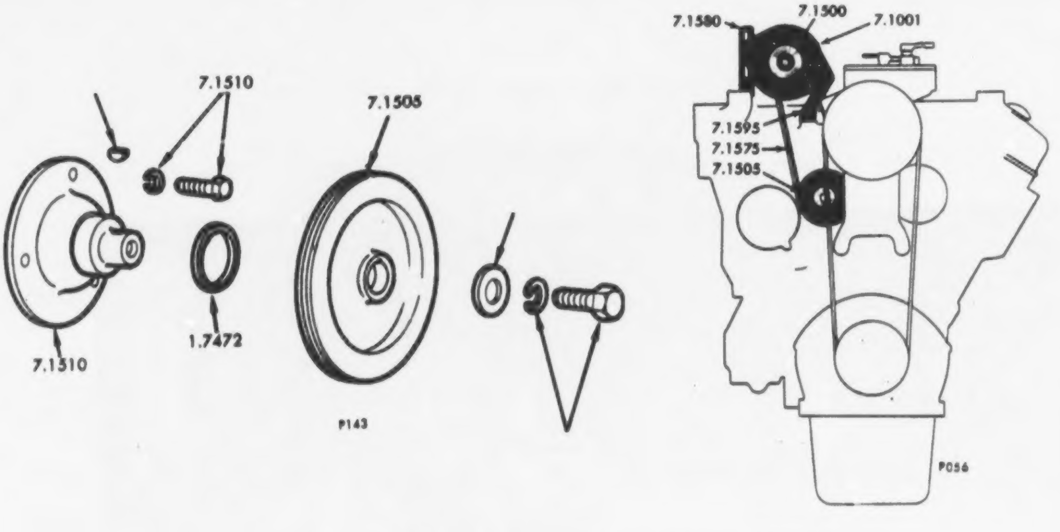

7.1510
7.1505
7.1510
1.7472
P143
7.1580
7.1500
7.1001
7.1595
7.1575
7.1505
P056

FIG. 1E HIGH MOUNTED CAMSHAFT DRIVEN, FRONT

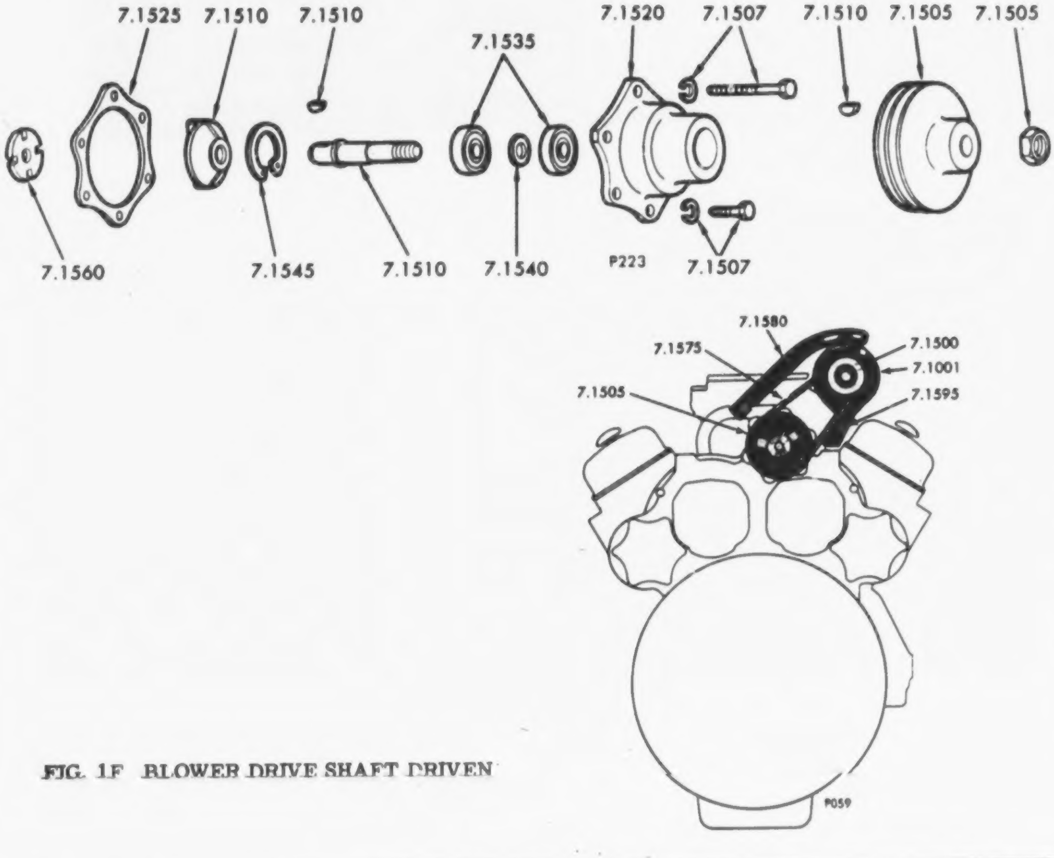
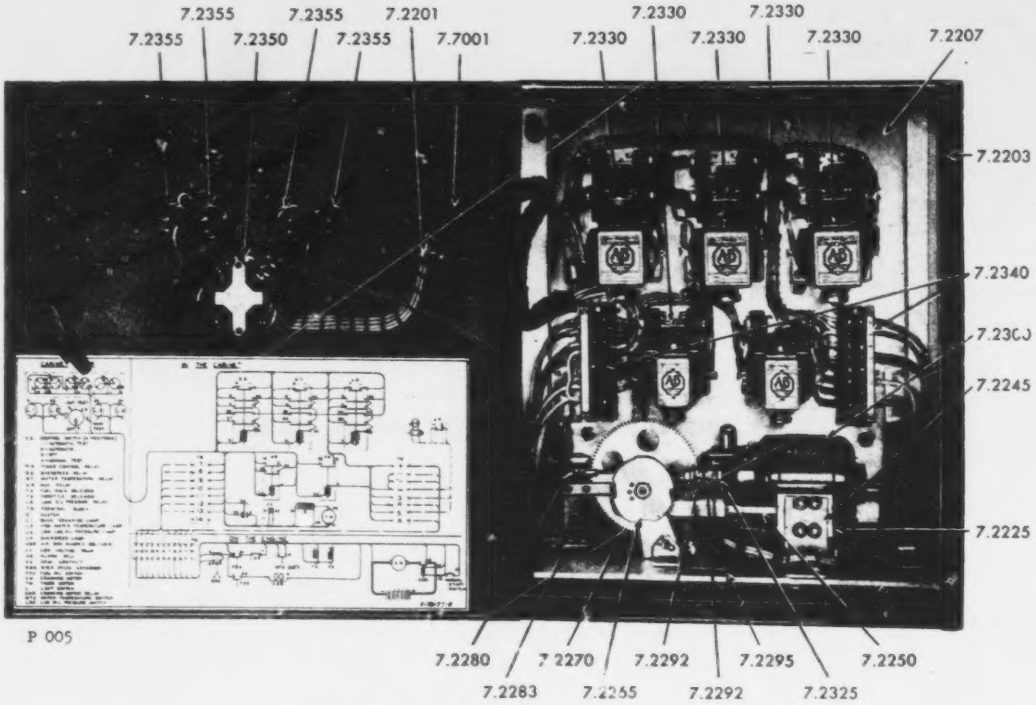

7.1525
7.1510
7.1510
7.1535
7.1520
7.1507
7.1510
7.1505
7.1505
7.1560
7.1545
7.1510
7.1540
P223
7.1507
7.1580
7.1575
7.1500
7.1001
7.1505
7.1595
P059

FIG. 1F BLOWER DRIVE SHAFT DRIVEN


7.2355
7.2355
7.2355
7.2350
7.2355
7.2201
7.7001
7.2330
7.2330
7.2330
7.2330
7.2330
7.2207
7.2203
7.2340
7.2300
7.2245
7.2225
7.2280
7.2283
7.2270
7.2265
7.2292
7.2292
7.2295
7.2325
7.2250

P 005

FIG. 2A AUTOMATIC STARTING CABINET

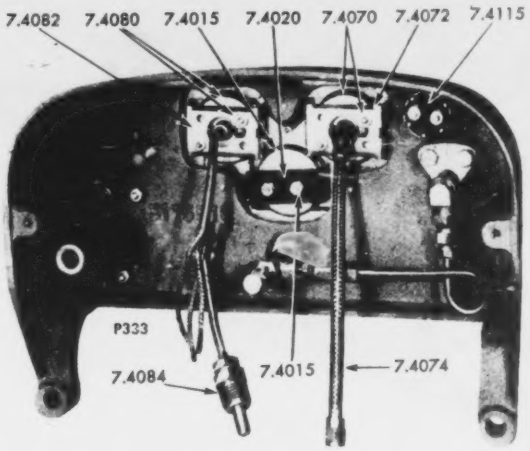

7.4082
7.4080
7.4015
7.4020
7.4070
7.4072
7.4115
P333
7.4084
7.4015
7.4074

FIG. 4A INSTRUMENT PANEL

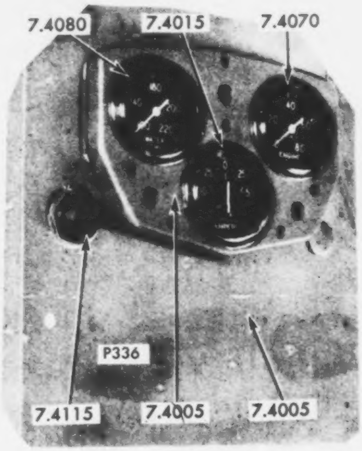

7.4080
7.4015
7.4070
P336
7.4115
7.4005
7.4005

FIG. 4D

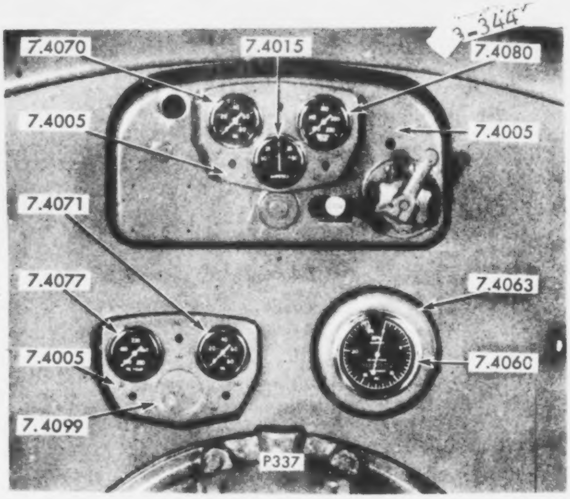
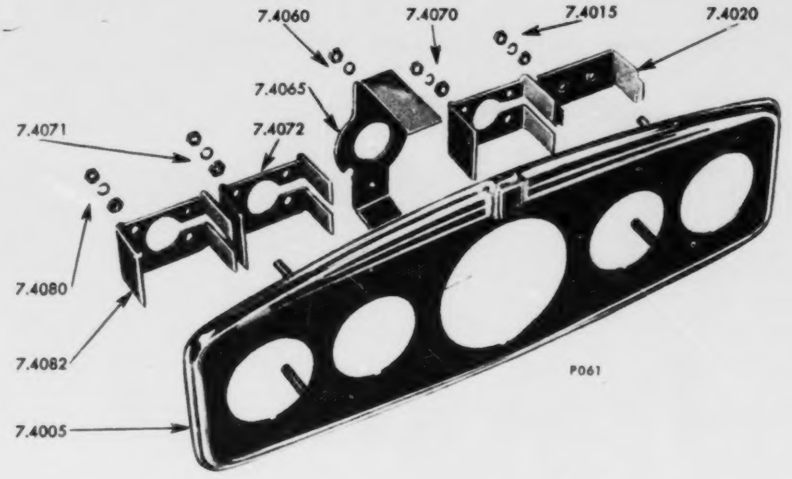

3-344
7.4070
7.4015
7.4080
7.4005
7.4005
7.4071
7.4077
7.4063
7.4005
7.4060
7.4099
P337

FIG. 4E

V-71


7.4060
7.4070
7.4015
7.4020
7.4065
7.4071
7.4072
7.4080
7.4082
7.4005
P061

INSTRUMENT PANEL

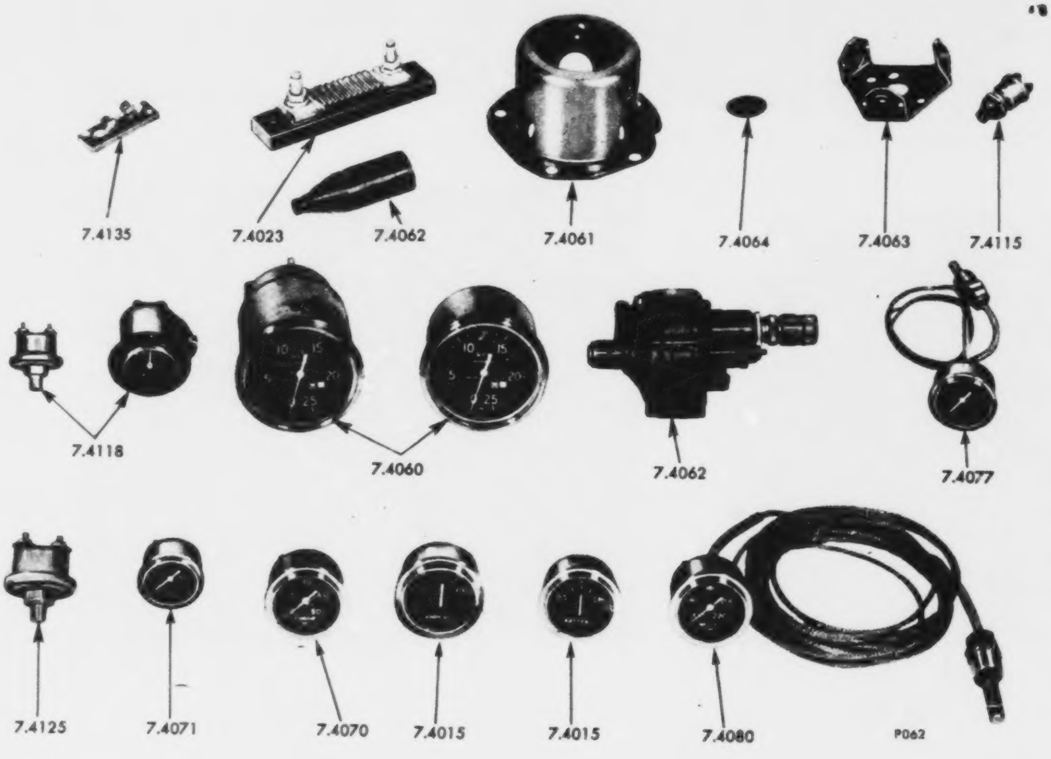

7.4135
7.4023
7.4062
7.4061
7.4064
7.4063
7.4115
7.4118
7.4060
7.4062
7.4077
7.4125
7.4071
7.4070
7.4015
7.4015
7.4080
P062

FIG. 4G

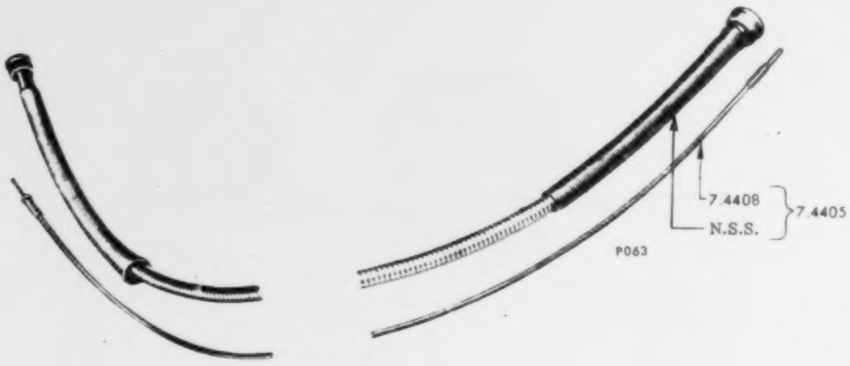
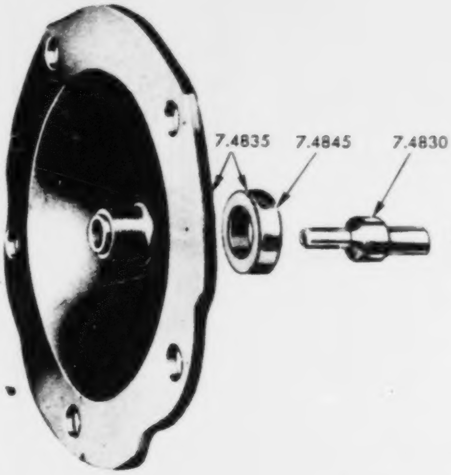

7.4408
N.S.S.
7.4405
P063

FIG. 5A


7.4835
7.4845
7.4830

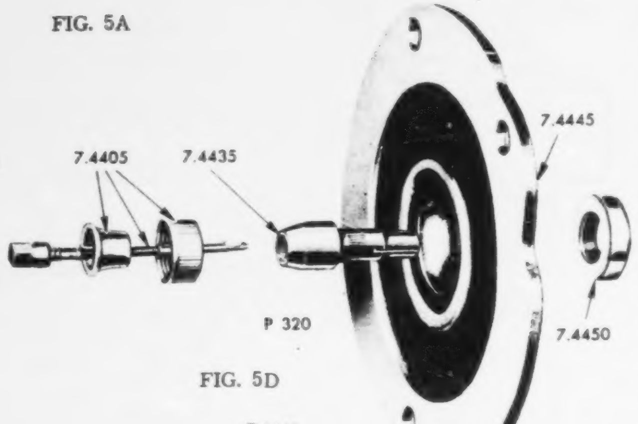

7.4405
7.4435
7.4445
P 320
7.4450

FIG. 5D

FIG. 5C

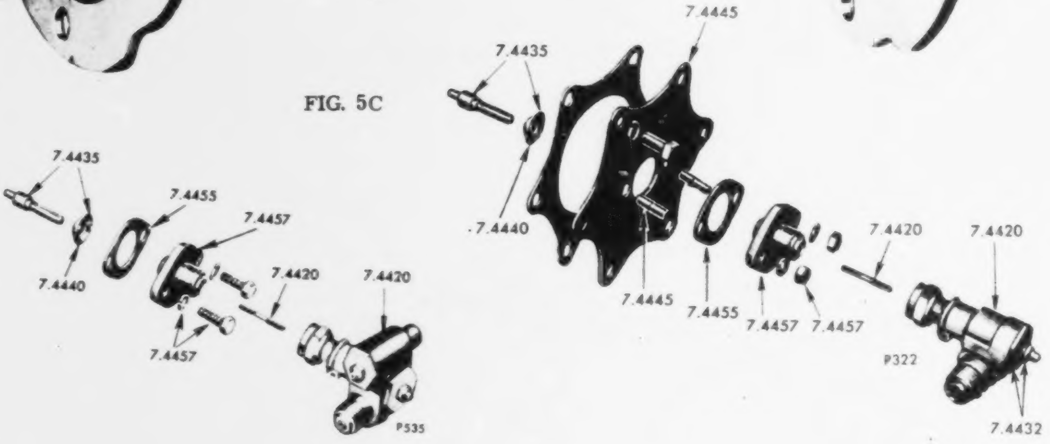

7.4445
7.4435
7.4435
7.4455
7.4457
7.4440
7.4420
7.4420
7.4457
P535
7.4440
7.4420
7.4420
7.4445
7.4455
7.4457
7.4457
P322
7.4432

FIG. 5B

TACHOMETER DRIVE

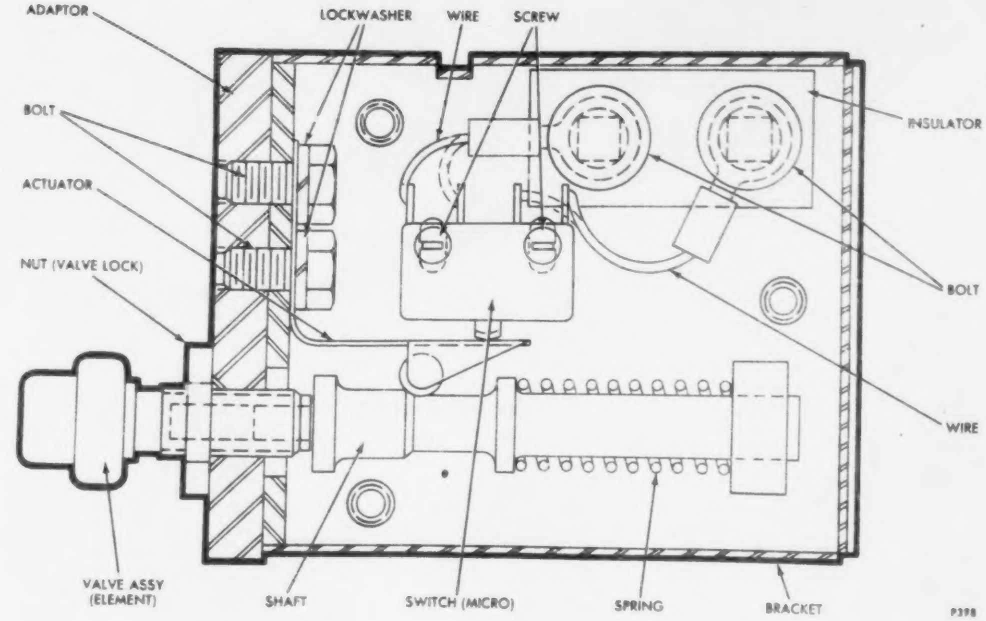

ADAPTOR
LOCKWASHER
WIRE
SCREW
BOLT
INSULATOR
ACTUATOR
NUT (VALVE LOCK)
BOLT
WIRE
VALVE ASSY (ELEMENT)
SHAFT
SWITCH (MICRO)
SPRING
BRACKET
P398

FIG. 5E SWITCH, WATER TEMPERATURE

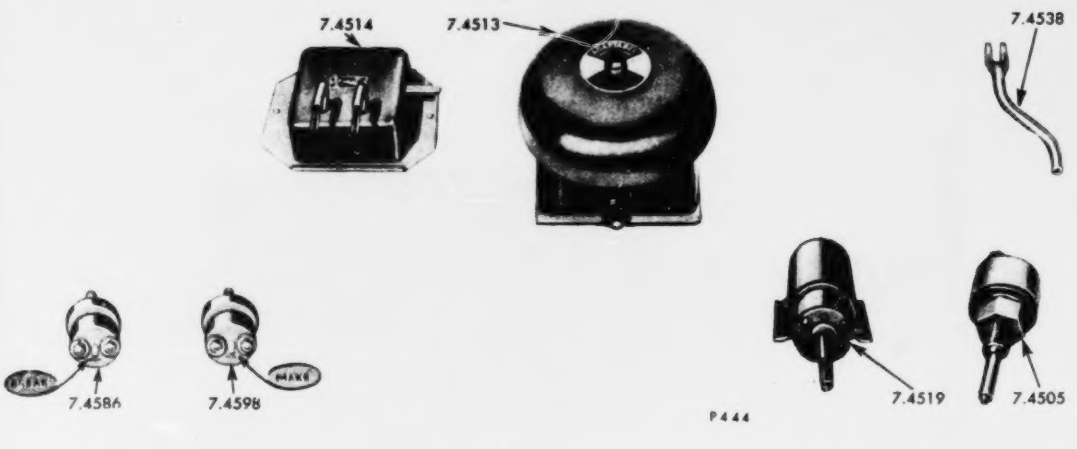

7.4514
7.4513
7.4538
7.4586
7.4598
P444
7.4519
7.4505

FIG. 6A SHUT-OFF OR ALARM SYSTEM

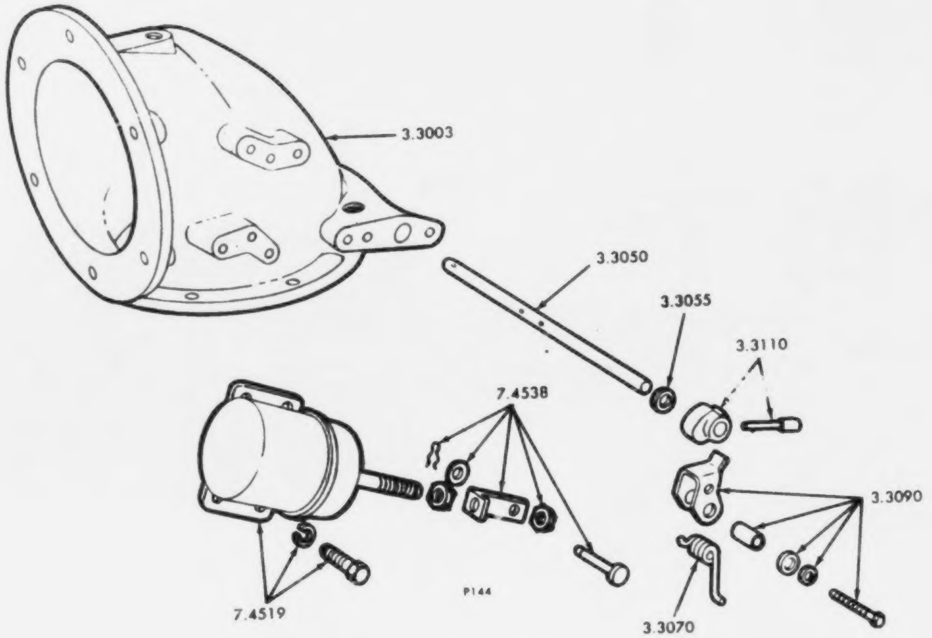

3.3003
3.3050
3.3055
3.3110
7.4538
3.3090
7.4519
P144
3.3070

FIG. 6B ELECTRICAL SHUTDOWN

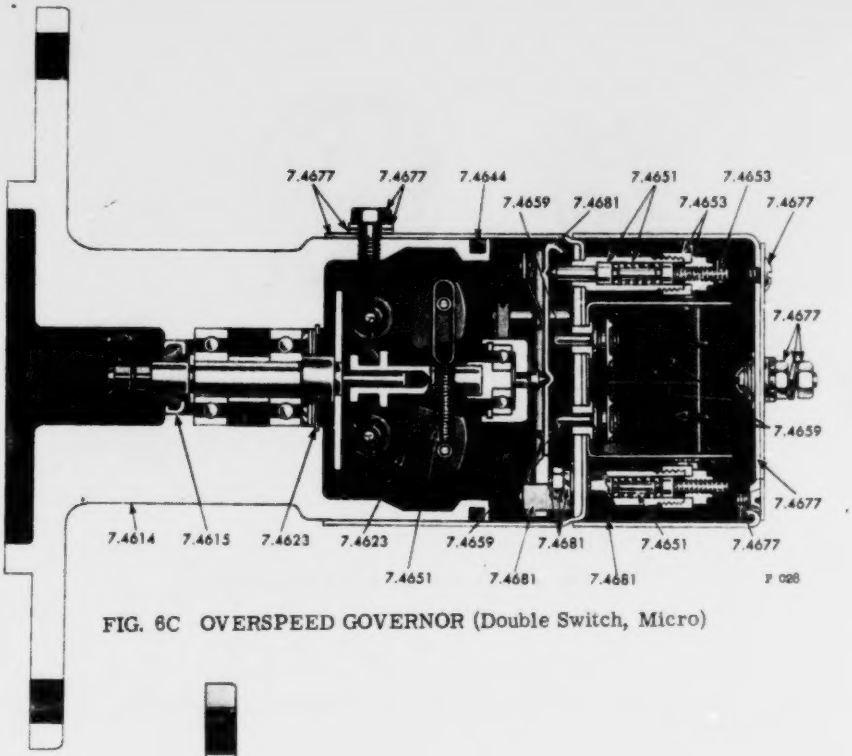

7.4677
7.4677
7.4644
7.4659
7.4681
7.4651
7.4653
7.4653
7.4677
7.4677
7.4659
7.4677
7.4614
7.4615
7.4623
7.4623
7.4659
7.4681
7.4651
7.4677
7.4651
7.4681
7.4681
P 028

FIG. 6C OVERSPEED GOVERNOR (Double Switch, Micro)

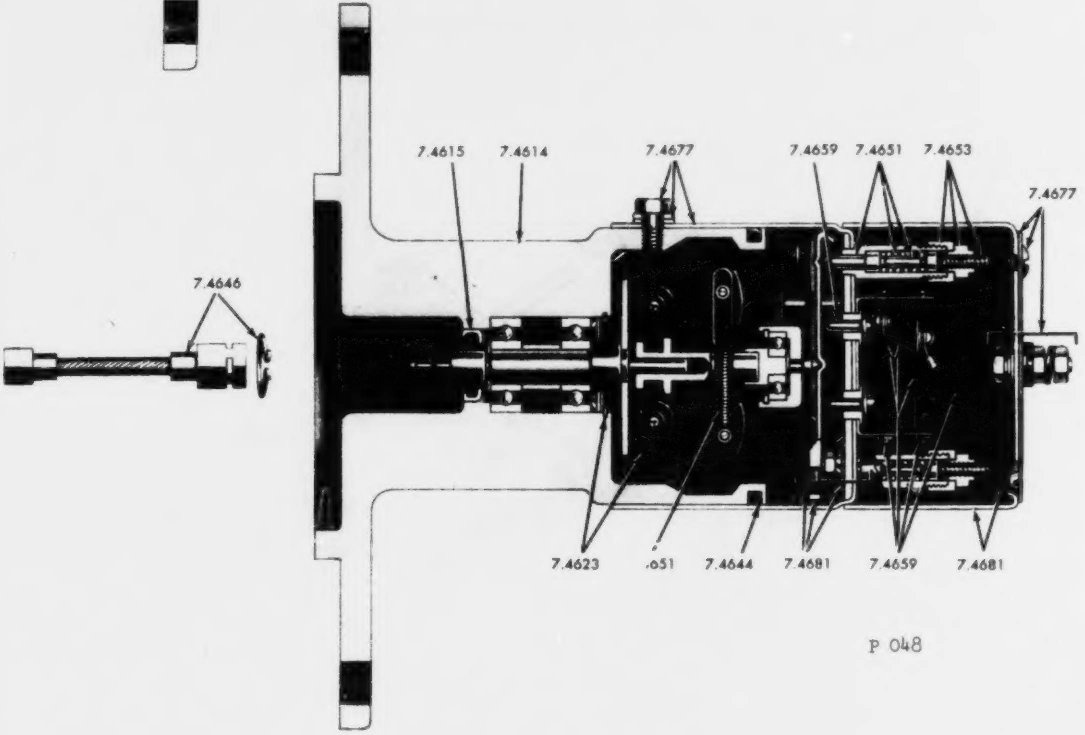
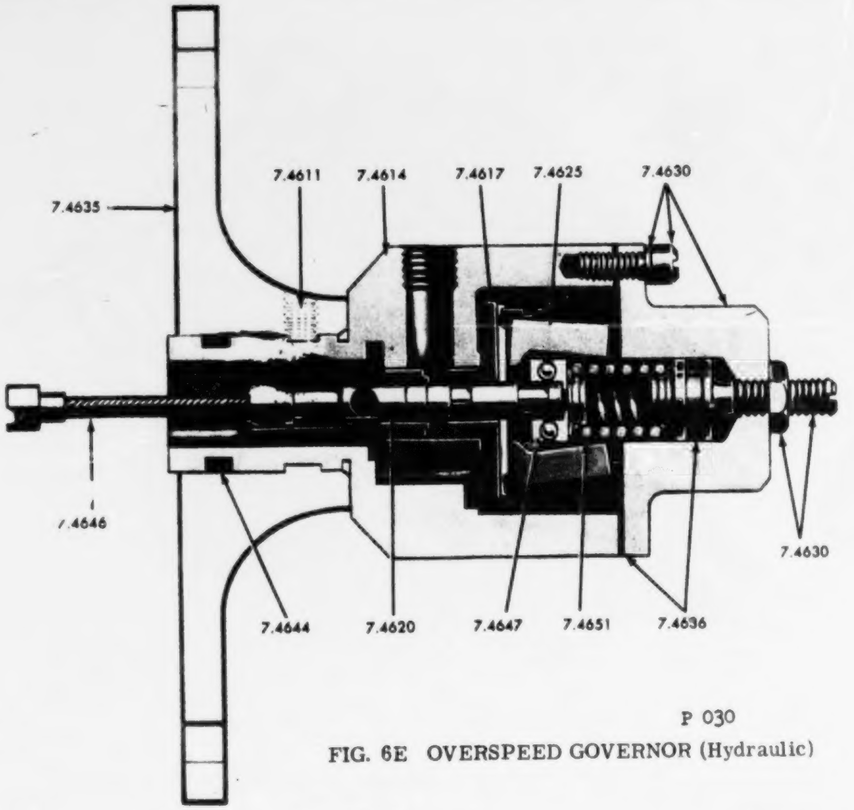
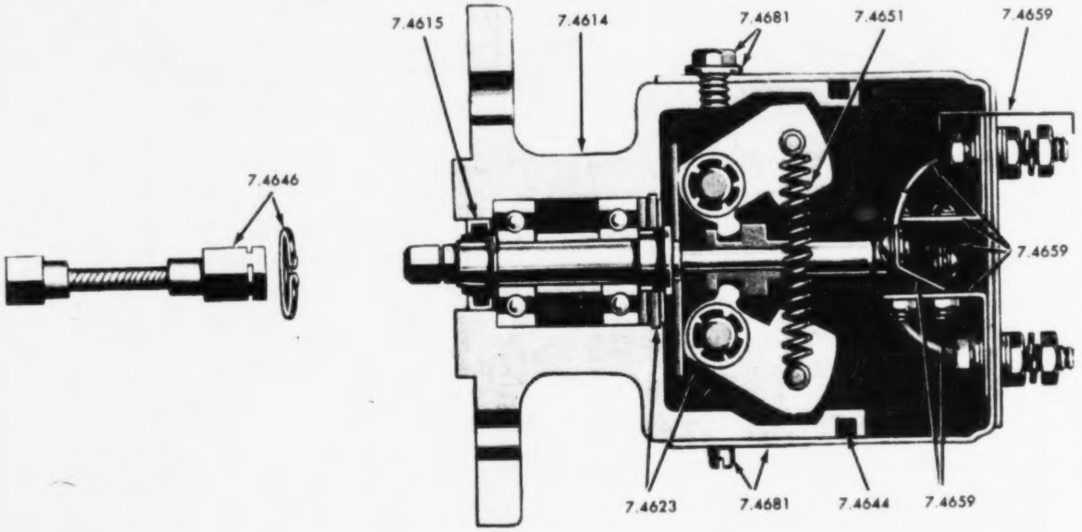

7.4646
7.4615
7.4614
7.4677
7.4659
7.4651
7.4653
7.4677
7.4623
.651
7.4644
7.4681
7.4659
7.4681
P 048

FIG. 6D OVERSPEED GOVERNOR (Double Switch, Licon)


7.4611
7.4614
7.4617
7.4625
7.4630
7.4635
7.4646
7.4630
7.4644
7.4620
7.4647
7.4651
7.4636

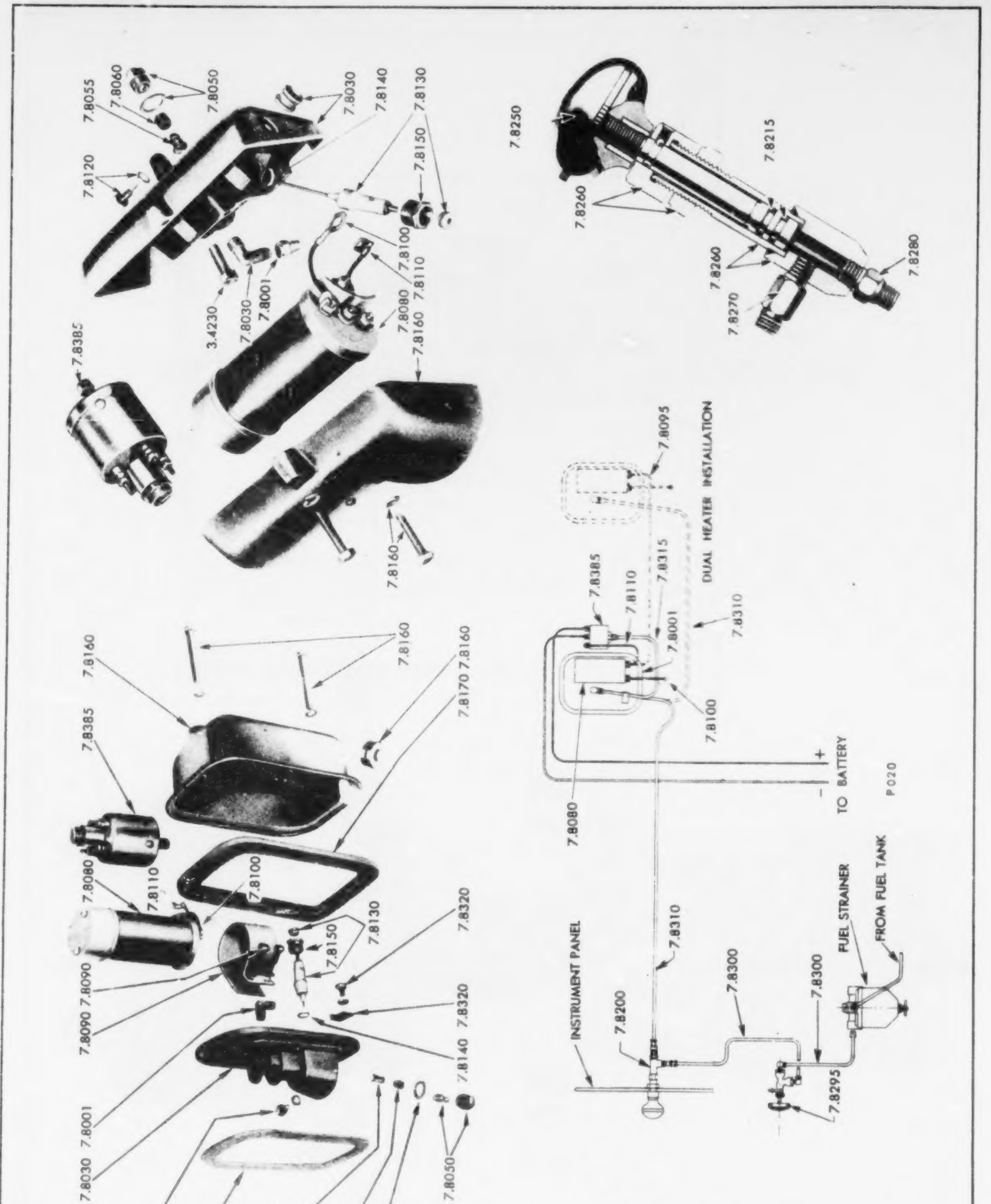
P 030

FIG. 6E OVERSPEED GOVERNOR (Hydraulic)


7.4615
7.4614
7.4681
7.4651
7.4659
7.4646
7.4659
7.4623
7.4681
7.4644
7.4659

P 029

FIG. 6F OVERSPEED GOVERNOR (Single Switch, Licon)


7.8060
7.8055
7.8050
7.8120
7.8030
7.8140
7.8130
7.8150
7.8100
7.8110
7.8080
7.8160
7.8001
7.8030
3.4230
7.8385
7.8160
7.8250
7.8215
7.8260
7.8260
7.8270
7.8280
7.8160
7.8385
7.8160
7.8170
7.8160
7.8080
7.8110
7.8100
7.8090
7.8090
7.8130
7.8150
7.8320
7.8320
7.8140
7.8001
7.8030
7.8120
1.1050
7.8055
7.8060
7.8050
7.8050
7.8095
DUAL HEATER INSTALLATION
7.8385
7.8110
7.8315
7.8001
7.8310
7.8100
7.8080
+
−
TO BATTERY
P020
INSTRUMENT PANEL
7.8200
7.8310
7.8300
7.8300
FUEL STRAINER
FROM FUEL TANK
7.8295

Figs. 9A, 9B, 9C & 9D of 7.0000

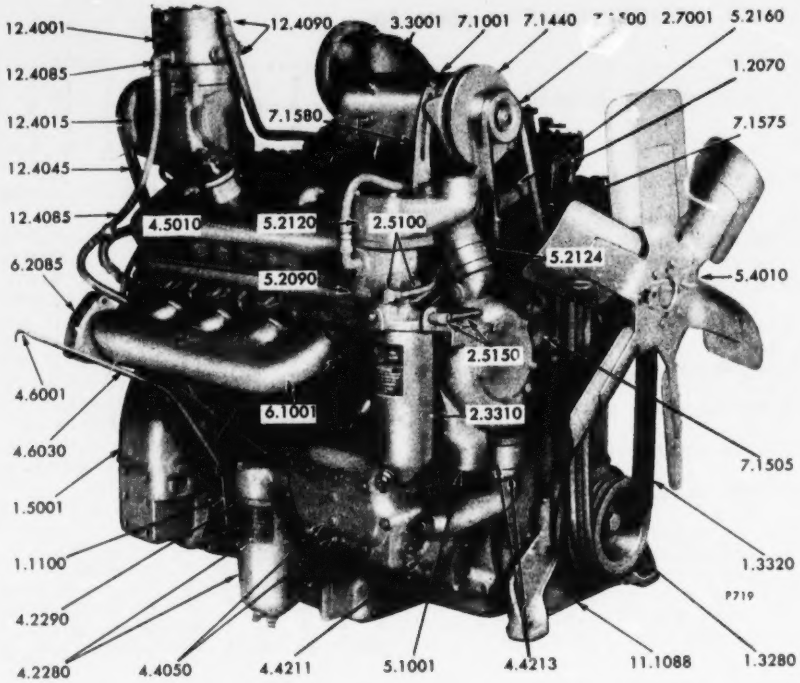

12.4001
12.4085
12.4015
12.4045
12.4085
6.2085
4.6001
4.6030
1.5001
1.1100
4.2290
4.2280
12.4090
3.3001
7.1001
7.1440
7.1500
2.7001
5.2160
1.2070
7.1575
7.1580
4.5010
5.2120
2.5100
5.2124
5.2090
5.4010
2.5150
6.1001
2.3310
7.1505
1.3320
P719
4.4050
4.4211
5.1001
4.4213
11.1088
1.3280

FIG. 10A

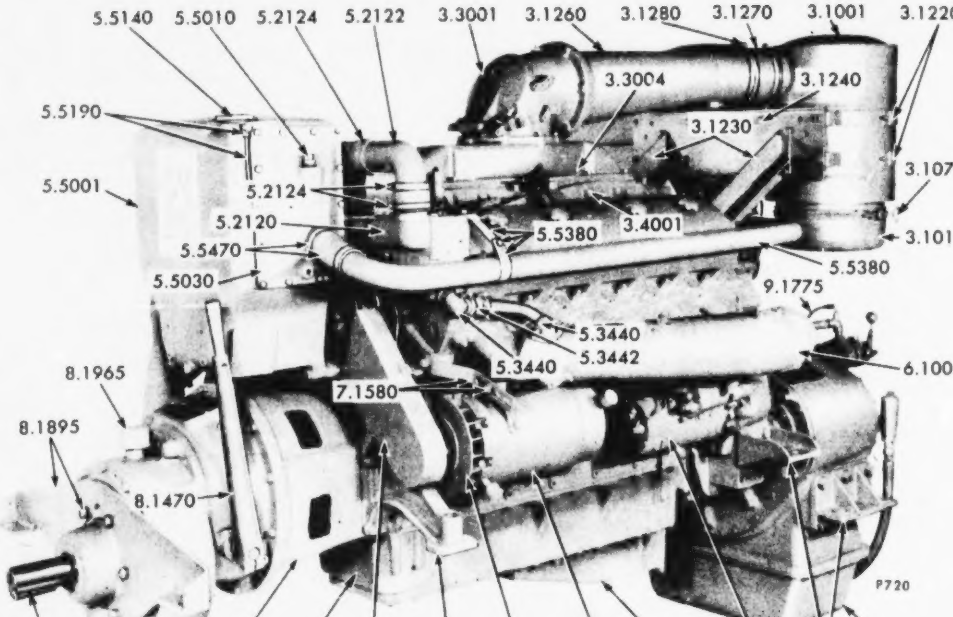

5.5140
5.5010
5.2124
5.2122
3.3001
3.1260
3.1280
3.1270
3.1001
3.1220
5.5190
3.3004
3.1240
3.1230
5.5001
5.2124
3.1070
5.2120
5.5380
3.4001
3.1010
5.5470
5.5380
5.5030
9.1775
5.3440
5.3442
5.3440
6.1001
8.1965
7.1580
8.1895
8.1470
P720
8.1001
8.1900
4.7010
7.1585
11.1070
7.1440
7.1001
4.7020
7.3001
11.1100

FIG. 10B

V-71

7.1000A BATTERY CHARGING GENERATOR

FIG	PART NUMBER	NAME AND DESCRIPTION	TYPES										
			1804	1805	1806	1807	1809	1810	1814	1815	1818	1823	1825
	7.1001	- GENERATOR ASSY.											
		NOTE SERVICE ON ELECTRICAL EQUIPMENT IN THIS SECTION SO INDICATED (*) IS HANDLED THRU UNITED DELCO.											
	1100081	* GENERATOR (12V., 65 AMP.)(C.W./ C.C.W.) . . .	1	1	1					1			
	1100077	* GENERATOR (24V., 65 AMP.) (C.W./ C.C.W.) . .				1	1	1					1
	1117236	* GENERATOR (24V., 50 AMP.) (C.W./ C.C.W.) . .							1				
	1117242	* GENERATOR (12V., 75 AMP.) (C.W./ C.C.W.) . .									1		
	1100079	* GENERATOR (12V., 45 AMP.) (C.W./ C.C.W.) . .										1	
	179886	BOLT, 1/2 -13X1 5/8 (12.9001) . . .							1	1			
	186631	BOLT, 1/2 -13X2 1/4 (12.9001) . . .							1	1			
	9427946	BOLT, 1/2 -13X6 1/4 (12.9001) . . .	1	1	1	1	1	1			1	1	1
	5132715	WASHER .53 X.94 X.12 (1.3140) . . .	2	2	2	2	2	2	2	2	2	2	2
	103323	LOCKWASHER, 1/2 (12.9200)	1	1	1	1	1	1	1	1	1	1	1
	102637	NUT, 1/2 -13 HEX. (12.9120)	1	1	1	1	1	1	1	1	1	1	1
	7.1500	- PULLEY, GENERATOR											
	5148796	PULLEY (2.76 DIA.,2 GROOVE)	1	1	1	1	1	1			1		
	5133093	PULLEY (2.76 DIA, 2 GROOVE)							1	1			
	5100633	PULLEY (2.76 DIA., 2 GROOVE)										1	1
	7.1505	- PULLEY, GENERATOR DRIVE											
	5102246	PULLEY (6.25 DIA., 2 GROOVE)					1				1		
1C,F	5133091	PULLEY (5.00 DIA., 2 GROOVE)										1	1
1C,D	5145905	PULLEY (6.29 DIA. 2 GROOVE)		1		1							
1C,F	5132669	PULLEY (6.29 DIA. 2 GROOVE)						1					
1C,F	5132667	PULLEY (6.29 DIA. 2 GROOVE)	1		1								
	5145390	PULLEY (9.00 DIA., 2 GROOVE)							1	1			
1F	124543	KEY, 1/8 X1/2 WOODRUFF (12.9350) . .										1	
	5139735	PLATE							1	1			
	180121	BOLT, 3/8 -16X748 (12.9001)							3	3		1	1
	5150230	WASHER, 3/8 FLAT (3.4120)										1	1
	5187641	WASHER, 25/64 X1 1/8 X1/16 (1.7605)							3	3			
	103321	LOCKWASHER, 3/8 (12.9200)							3	3		1	1
	103904	KEY, 3/32" x 1/2"											1
	7.1575	- BELT, GENERATOR DRIVE											
	5101500	BELT SET (2 BELTS) (47.00 L.X.380 W.	1	1	1	1	1	1			1		
	5141704	BELT SET (2 BELTS) (50.00L.,X.380 W)							1	1			
	5133176	BELT SET (2 BELTS) (38.00L.,X.380 W)										1	1

7.1000A BATTERY CHARGING GENERATOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	1804	1805	1806	1807	1809	1810	1814	1815	1818	1823	1826
		7.1580 - STRAP, GENERATOR ADJUSTING											
	5101577	STRAP							1	1			
	5148407	STRAP										1	1
	5101370	STRAP	1	1	1	1	1	1			1		
	5182680	SPACER, 7/8 -13/32 X2.50 (7.6001)							1	1			
	455537	BOLT, 3/8 -16X4 (12.9001)							1	1			
	179839	BOLT, 3/8 -16X1 (12.9001)										1	1
	442733	BOLT, 1/2 -13X1 1/4 (12.9001)	2	2	2	2	2	2	1	1	2	1	2
	5117082	WASHER, .53 X1.16	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	1
	103321	LOCKWASHER, 3/8 (12.9200)							1	1		1	1
	103323	LOCKWASHER, 1/2 (12.9200)	AR	AR	AR	AR	AR	AR	AR	AR	AR	AR	1
	123221	NUT, 3/8 -16 HEX. (12.9120)										1	
	103341	WASHER, 3/8"											1
		7.1582 - BRACKET, GENERATOR ADJUSTING STRAP											
	5137851	BRACKET										1	1
	112609	BOLT, 3/8 -16X3 3/4 (12.9001)										2	2
	103341	WASHER, 3/8 (12.9150)										2	
	123221	NUT, 3/8" - 16											1
	103321	LOCKWASHER, 3/8"											2
		7.1585 - GUARD, GENERATOR DRIVE BELT AND PULLEY											
	5144929	GUARD		1	1		1	1			1		
	5129317	GUARD							1	1			
		7.1587 - BRACKET, GENERATOR DRIVE BELT AND PULLEY GUARD											
	5128536	BRACKET		1	1		1	1			1		
	5131202	BRACKET (LONG)							1	1			
	5131201	BRACKET (SHORT)							1				
	5108612	BRACKET (4.4335)								2			
	5144792	BRACKET (UPR)		1	1		1	1			1		
	5144930	BRACKET (INBD)		1	1		1	1			1		
	5130179	SPACER, 3/4 X.40 X.18 (12.5023)		1	1		1	1			1		
	5131852	SPACER, 1/2 X3 1/2 (7.1590)								2			
	5101265	RETAINER, CLIP (7.1585)		3	3		3	2			3		
	120628	BOLT, 1/4 -20X1/2 (12.9025)		3	3		3	3			33		
	186619	BOLT, 3/8 -16X1 1/8 (12.9001)		1	1		1	1			1		
	186622	BOLT, 3/8 -16X1 1/4 (12.9001)		1	1		1	1			1		
	120392	WASHER, 9/32 (12.9150)		3	3		3	2			3		
	103341	WASHER, 3/8 (12.9150)		2	2		2	2			2		
	103320	LOCKWASHER, 5/16 (12.9200)							3	3			
	103321	LOCKWASHER, 3/8 (12.9200)		1	1		1	2			1		
	114493	NUT, 5/16 -24 (12.9190)							3	3			

7.1000A BATTERY CHARGING GENERATOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	1804	1805	1806	1807	1809	1810	1814	1815	1818	1823	1826
	7.1595	- BRACKET, GENERATOR MCUNTING											
1E,F	5137450	BRACKET							1	1			
	5101371	BRACKET	1	1	1	1	1	1			1		
	5101321	BRACKET							1	1			
	5103157	BRACKET										1	1
	5164294	SPACER 13/32 X7/8 X1/8							2	1			
	186647	BOLT, 1/4 -20X1 (12.9001)										2	
	179839	BOLT, 3/8 -16X1 (12.9001)							1	2		2	
	186622	BOLT, 3/8 -16X1 1/4 (12.9001)	4	4	4	4	4	4	4	4	4		
	179862	BOLT, 7/16 -14X1 1/2 (12.9001)										1	
	5175709	WASHER, 1/4 (COPPER)										2	
	5152148	WASHER, 9/16 (COPPER) (2.4050)										2	
	103321	LOCKWASHER, 3/8 (12.9200)	4	4	4	4	4	4	6	6	4		2
	103322	LOCKWASHER, 7/16 (12.9200)										2	1
	103319	LOCKWASHER, 1/4"											2
	5104593	BOLT, 1/4" – 20 x 1" (W/SEAL PATCH)											2
	5104154	BOLT, 3/8" – 16 x 1" (W/SEAL PATCH)											2
	5104609	BOLT, 7/16" – 14 x 1.50" (W/SEAL PATCH)											1
	5124331	TUBE											1
	7.1597	GASKET, GENERATOR MOUNTING BRACKET											
	5122266	GASKET											1
	7.1510	HUB, GENERATOR DRIVE PULLEY											
	5117920	SHAFT (1.7640)											1
	181596	BOLT 5/16" – 24 x 7/8											3
	103320	LOCKWASHER, 5/16"											3
	7.1515	SEAL, GENERATOR DRIVE OIL											
	5177786	SEAL (2.8810)											1

Detroit Diesel Allison
Division of General Motors Corporation

ENGLISH TO METRIC CONVERSIONS

Multiply	by	to get equivalent number of:
	LENGTH	
Inch	25.4	millimetres (mm)
Foot	0.304 8	metres (m)
Yard	0.914 4	metres
Mile	1.609	kilometres (km)
	AREA	
Inch²	645.2	millimetres² (mm²)
	6.45	centimetres² (cm²)
Foot²	0.092 9	metres² (m²)
Yard²	0.836 1	metres²
	VOLUME	
Inch³	16 387.	mm³
	16.387	cm³
	0.016 4	litres (l)
Quart	0.946 4	litres
Gallon	3.785 4	litres
Yard³	0.764 6	metres³ (m³)
	MASS	
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons

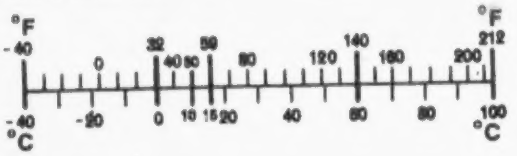
Multiply	by	to get equivalent number of:
	ACCELERATION	
Foot/sec²	0.304 8	metre/sec² (m/s²)
Inch/sec²	0.025 4	metre/sec²
	TORQUE	
Pound-inch	0.112 98	newton-metres (N·m)
Pound-foot	1.355 8	newton-metres
	POWER	
Horsepower	0.746	kilowatts (kW)
	PRESSURE OR STRESS	
Inches of mercury	3.377	kilopascals (kPa)
Inches of water	0.249 1	kilopascals
Pounds/sq. in.	6.895	kilopascals
	ENERGY OR WORK	
BTU	1 055.	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3.6×10^6 or 3 600 000	joules (J = one W·s)
	LIGHT	
Footcandle	10.76 4	lumens/metre² (lm/m²)
	FUEL PERFORMANCE	
Miles/gal	0.425 1	kilometres/litre (km/l)
Gal/mile	2.352 7	litres/kilometre (l/km)
	VELOCITY	
Miles/hour	1.609 3	kilometres/hr (km/h)

Degree (angle)	0.017 5	radians (rad)
Ounce (mass)-inch (balancing)	720.077 8	milligram-metre (mg·m)

TEMPERATURE

$°F = \frac{9}{5}(°C) + 32$

$°C = \frac{5}{9}(°F - 32)$



USE CONVERSION TABLES LIKE THIS:

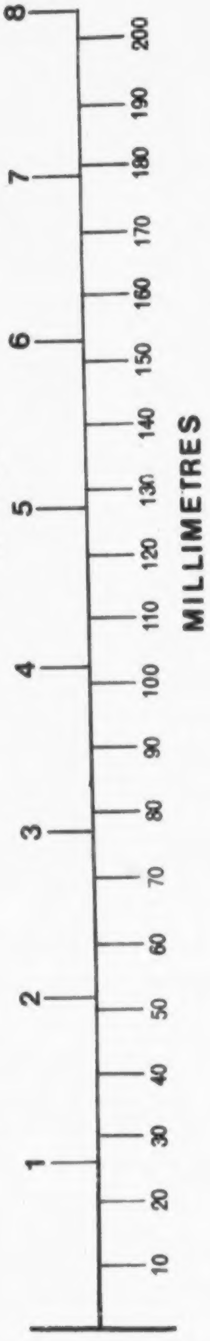
13 hp = ? kW Read across the 10 line to the 3 column. Read 9.7 kW

POWER – HORSEPOWER TO KILOWATTS

(1 hp = 0.7456999 kW)

hp	0	1	2	3	4	5	6	7	8	9
	kW	kW	kW	kW	kW	kW	kW	kW	kW	
0		0.75	1.49	2.24	2.98	3.73	4.47	5.22	5.9	
10	7.5	8.2	8.9	9.7	10.4	11.2	11.9	12.7		
20	14.9	15.7	16.4	17.2	17.9	18.6	19.4	20		
30	22.4	23.1	23.9	24.6	25.4	26.1				

11883A



7.3000A STARTING MOTOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	15	18	19	22	34	36	40	80	176	179	183	184
	7.3001	- MOTOR ASSY., STARTING												
		NOTE SERVICE ON ELECTRICAL EQUIPMENT IN THIS SECTION SO INDICATED (*) IS HANDLED THRU UNITED DELCO.												
108	1114078	* MOTOR ASSY. (12V., INSL., C.W., SPRAG)	1											
108	1114080	* MOTOR ASSY. (12V., INSL., C.C.W., SPRAG)		1										
108	1114082	* MOTOR ASSY. (12V., GRD., C.W., SPRAG)							1					
108	1114084	* MOTOR ASSY. (12V., GRD., C.W., SPRAG)								1				
108	1114085	* MOTOR ASSY. (12V., GRD., C.W., DYER)										1		
108	1113874	* MOTOR ASSY. (24V., INSL., C.C.W., SPRAG)					1							
108	1113824	* MOTOR ASSY. (24V., INSL., C.W., SPRAG)						1						
108	1113938	* MOTOR ASSY. (24V., GRD., C.W., SPRAG)									1			
108	1113878	* MOTOR ASSY. (32V., INSL., C.W., SPRAG)			1									
108	1113889	* MOTOR ASSY. (32V., INSL., C.C.W., SPRAG)				1								
108	1109963	* MOTOR ASSY. (32V., INSL., C.W., SPRAG)											1	
108	1109964	* MOTOR ASSY. (32V., INSL., C.C.W., SPRAG)												1
	9418228	BOLT, 5/8 -11X1 3/4 (12 PT.) (12.9005)	1	1	1	1	1	1	1	1	1	1	1	1
	223435	BOLT, 5/8 -11X1 3/4 (12.9001)	2	2	2	2	2	2	2	2	2	2	2	2
	103325	LOCKWASHER, 5/8 (12.9200)	3	3	3	3	3	3	3	3	3	3	3	3
		* PROCURE FROM UNITED DELCO.												
	7.3004	- GASKET, STARTING MOTOR												
	5130995	GASKET (W/WET FLYWHEEL HOUSING)	1	1	1	1	1	1	1	1		1	1	1

7.4000B TACHOMETER DRIVE

FIG.	PART NUMBER	NAME AND DESCRIPTION	1	1C	11	23	24	25	26	46	47	115	131	135
		7.4435 - SHAFT, TACHOMETER DRIVE												
		A SHAFT ASSY. INCLUDES SLINGER IN 7.4440.												
5B	3224992	SHAFT	1									1		
5C	5188558	SHAFT ASSY.				1	1	1						
5D	5158289	SHAFT (7.4457)							1					
5C	5155661	SHAFT ASSY.			1								1	
		7.4440 - SLINGER, TACHOMETER DRIVE SHAFT OIL												
5B	5155818	SLINGER			1	1	1	1	1				1	
		7.4445 - COVER, TACHOMETER DRIVE												
5C	5125153	COVER ASSY. (INCLUDES SEAL IN 7.4450)	1									1		
5D	5124240	COVER ASSY. (INCLUDES SEAL IN 7.4450)							1					
5B	5168555	COVER ASSY.							1					
	5123118	COVER ASSY. (INCLUDES STUDS)			1								1	
5B	5155654	STUD (5/16 -24X1 1/32)							2				2	
	179858	BOLT, 7/16 -14X1 (12.9001)	1						1			1		
	179882	BOLT, 1/2 -14X1 1/8 (12.9001)	4						4			4		
	5132715	WASHER, (.53" I.D. x .94" O.D. x .12 THK.)	2											
		7.4450 - SEAL, TACHOMETER DRIVE COVER												
5C,D	3202615	SEAL	1		1				1				1	
		7.4455 - GASKET, TACHOMETER DRIVE ADAPTOR												
5B	5135935	GASKET			1	1	1	1					1	
		7.4457 - ADAPTOR, TACHOMETER DRIVE												
5B	5155819	ADAPTOR (1.34)			1	1	1	1					1	
	849330	CAP	1			1	1	1					1	
5B	179816	BOLT, 5/16 -18X3/4 (12.9001)				2	2	2						
	2071181	WASHER, 5/16 (7.4850)											1	
	103320	LOCKWASHER, 5/16 (12.9200)			2	2	2	2					2	
5B	114493	NUT, 5/16 -24 HEX. (12.9120)			2								2	
	1568220	WASHER, 7/16" x 27/32" (7.4860)	1											

Volume 4

Alternator, Starter & Battery Service Information & Parts Lists

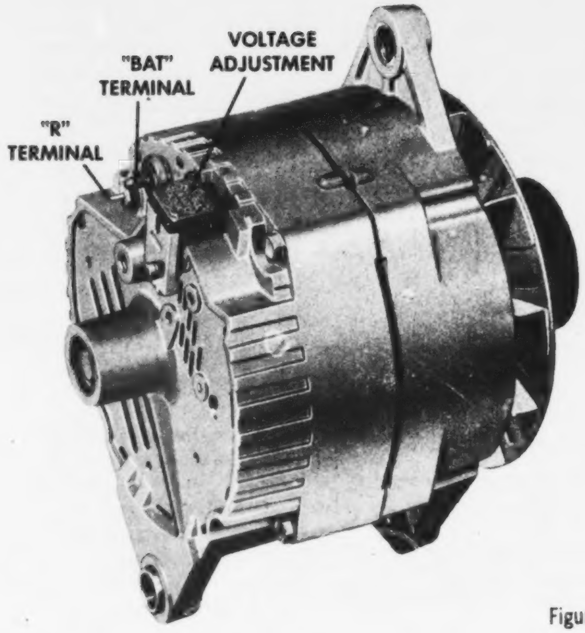
750 CFM Rotary Screw Air Compressor

Stock Number 4310-01-053-3891
Contract DSA700-77-C-8407

INTEGRAL CHARGING SYSTEM

(27-SI Series, 200 Type)

(WITH THREE-TERMINAL REGULATOR)



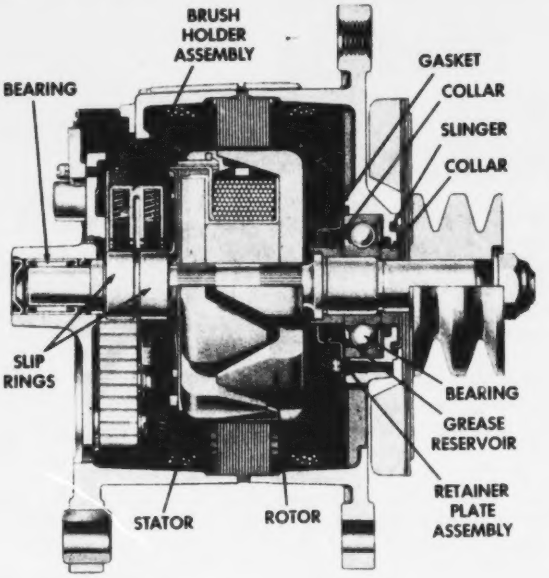


Figure 2—Cross-sectional view of typical Integral Charging System.

Figure 1—Typical 27-SI Series Integral Charging System.

THIS BULLETIN IS DIVIDED INTO FOUR SECTIONS:

- **Introduction—Page 1**
- **Operating Principles—Page 2**
- **Troubleshooting Procedures—Page 3**
- **Generator Repair—Page 5**

INTRODUCTION

The Integral Charging System illustrated in Figure 1 features a solid state regulator that is mounted inside the slip ring end frame. The regulator voltage setting can be adjusted externally by repositioning a voltage adjustment cap in the slip ring end frame. This feature is covered in detail in Figure 5. Only one wire is needed to connect the Integral Charging System to the Energizer, or battery, along with an adequate ground return. An "R" terminal is provided to operate auxiliary equipment in some circuits.

The bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator a.c. voltages to a d.c. voltage which appears at the output terminal. Field current is supplied through a diode trio which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

OPERATING PRINCIPLES

Typical wiring diagrams are shown in Figure 3. The basic operating principles are explained as follows:

With the Integral Charging System operating, a.c. voltages initially are generated in the stator windings by residual magnetism in the rotor. The diodes in the rectifier bridge change the stator a.c. voltages to a d.c. voltage which appears between ground and the "BAT" terminal. As speed increases, current is provided for charging the Energizer or battery and operating electrical accessories.

Current also flows from the stator and rectifier bridge through resistor R1 and resistor R4 to turn transistor TR1 on.

The stator then supplies d.c. field current through the diode trio, the field, TR1, and then through the diodes in the rectifier bridge back to the stator.

As the speed and voltage increase the voltage between R2 and R3 increases to the value where zener diode D1 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease and D1 then blocks current flow causing TR1 to turn back on. The field current and system voltage increase and this cycle then repeats many times per second to limit the voltage to the adjusted value.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D2 prevents high-induced-voltages in the field windings when TR1 turns off.

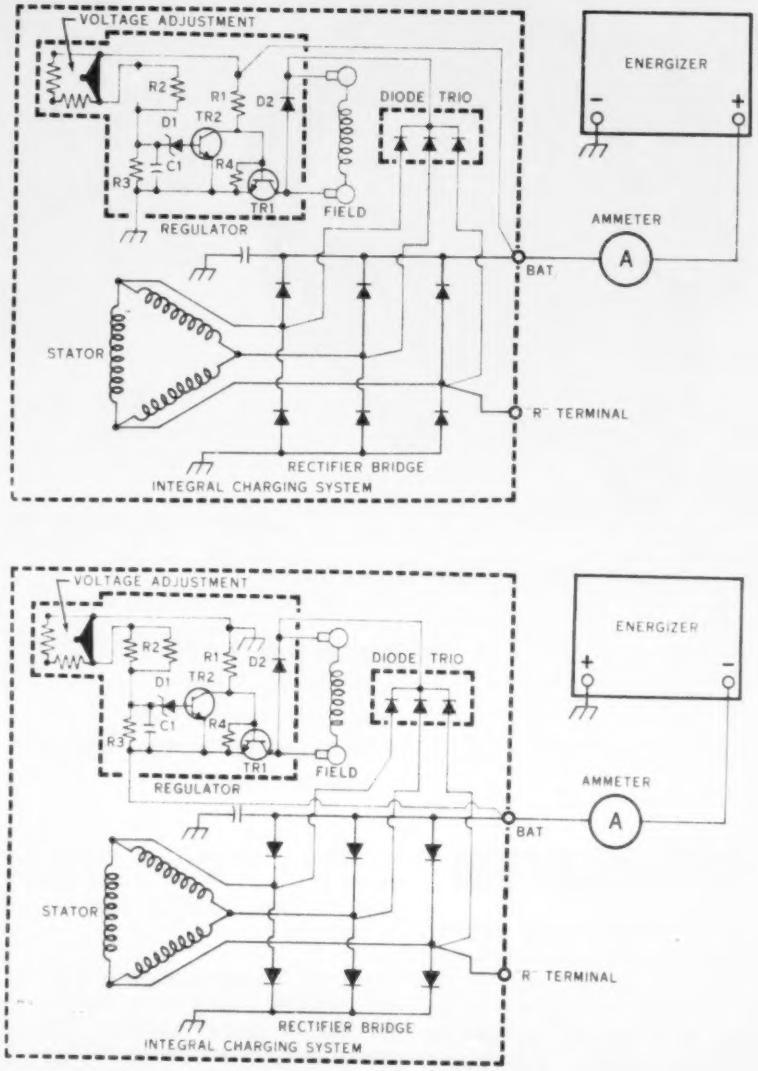

VOLTAGE ADJUSTMENT
R2
R1
D2
D1
TR2
C1
R4
R3
TR1
REGULATOR
FIELD
DIODE TRIO
ENERGIZER
−
+
AMMETER
A
BAT
STATOR
"R" TERMINAL
RECTIFIER BRIDGE
INTEGRAL CHARGING SYSTEM
VOLTAGE ADJUSTMENT
R2
R1
D2
D1
TR2
C1
R4
R3
TR1
REGULATOR
FIELD
DIODE TRIO
ENERGIZER
+
−
AMMETER
A
BAT
STATOR
"R" TERMINAL
RECTIFIER BRIDGE
INTEGRAL CHARGING SYSTEM

Figure 3—Typical 27-SI wiring diagrams showing internal circuits. (Negative ground shown above, positive ground shown below.)

TROUBLESHOOTING PROCEDURES

(Close adherence to the following procedures in the order presented will lead to the location and correction of charging system defects in the shortest possible time. Only a portion of these procedures need be performed. It will never be necessary to perform all the procedures in order to locate the trouble.)

A basic wiring diagram showing lead connections is shown in Figure 4. To avoid damage to the electrical equipment, always observe the following precautions:

- Do not polarize the Integral Charging System.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed herein.
- Make sure the Integral Charging System and battery or Energizer have the same ground polarity.
- When connecting a charger or a booster battery to the vehicle battery, or Energizer, connect negative to negative and positive to positive.

Trouble in the charging system will show up as one or more of the following conditions:

A. An undercharged battery, or Energizer, as evidenced by slow cranking and low specific gravity readings.

B. An overcharged battery, or Energizer, as evidenced by excessive water usage.

A. UNDERCHARGED ENERGIZER

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions:

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery or Energizer defect is suspected, check per the applicable Delco-Remy Service Bulletin.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the cable clamps and Energizer posts.
5. Connect a voltmeter from "BAT" terminal on Integral Charging System to ground. A zero reading indicates an open between voltmeter connection and Energizer.

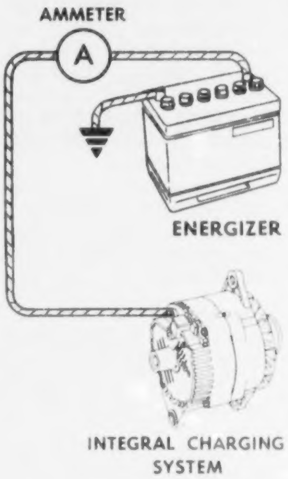


Figure 4—Typical wiring diagram showing basic lead connections.

6. If previous Steps 1 through 5 check satisfactorily, check Integral Charging System as follows:
   a. Disconnect Energizer ground cable.
   b. Connect an ammeter in the circuit at the "BAT" terminal of the Integral Charging System.
   c. Reconnect Energizer ground cable.
   d. Turn on accessories. Connect a carbon pile across the Energizer.
   e. Operate engine at moderate speed as required, usually 4000 generator r.p.m. or more, and adjust carbon pile as required, to obtain maximum current output.

   IMPORTANT: Initial voltage build-up is by residual magnetism in the rotor. Increase the speed as required to obtain maximum current output.

   f. If ampere output is within 10 amperes of rated output as stamped on generator frame, Integral Charging System is not defective. In this case, an adjustment of the voltage setting may correct the undercharged condition. Raise the setting by removing the voltage adjusting cap, rotating in increments of 90°, and then re-inserting the cap in the connector body. As illustrated in Figure 5, the cap is set for medium high voltage. With position 2 aligned with the arrow, the setting is medium low, position "LO" is low and position "HI" is the highest regulator setting. After adjusting the setting, check for an improved Energizer condition after a service period of reasonable length, such as one week. IMPORTANT: The voltage adjustment in Figure 5 is for purposes of illustration only. The actual adjustment as shipped from the factory may be in some other position, depending on the application requirement.

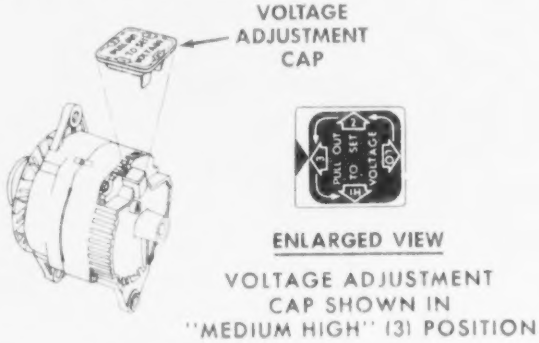


Figure 5—Voltage adjustment cap.

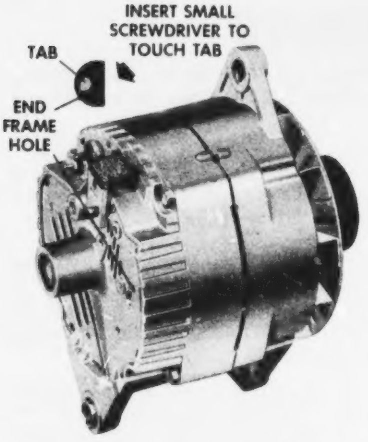

INSERT SMALL SCREWDRIVER TO TOUCH TAB
TAB
END FRAME HOLE

Figure 6—Testing generator. **(Wiring connections not shown.)**

g. If ampere output is not within 10 amperes of rated output as stamped on Integral Charging System frame:

Negative ground only — Insert screwdriver into end frame hole to ground tab to end frame (Fig. 6). CAUTION: Tab is within ¾ inch of casting surface. Do not force screwdriver deeper than one inch into end frame. Proceed to Step h.

Positive ground only—Insert small screwdriver into end frame hole to touch tab. Connect voltmeter to metal screwdriver and Integral Charging System "BAT" terminal. If reading is battery voltage, replace rotor and regulator, as both are defective. If reading is not battery voltage, disconnect voltmeter and connect a jumper lead from metal screwdriver to Integral Charging System "BAT" terminal. Proceed to Step h.

h. Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.

i. If output is within 10 amperes of rated output, replace regulator as covered in "Integral Charging System Repair" section, and check field winding.

j. If output is not within 10 amperes of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in "Integral Charging System Repair" section.

k. Remove ammeter from generator and turn accessories off.

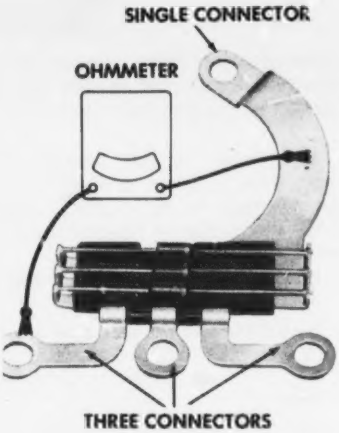

SINGLE CONNECTOR
OHMMETER
THREE CONNECTORS

Figure 9—Diode trio check.

B. OVERCHARGED ENERGIZER

1. Check the battery or Energizer per the applicable Delco-Remy Service Bulletin. IMPORTANT—Remember that an overheated battery or Energizer will be overcharged even though no charging circuit defects are present.

2. If Energizer or battery is not defective or overheated, connect a voltmeter between Integral Charging System "BAT" terminal and ground.

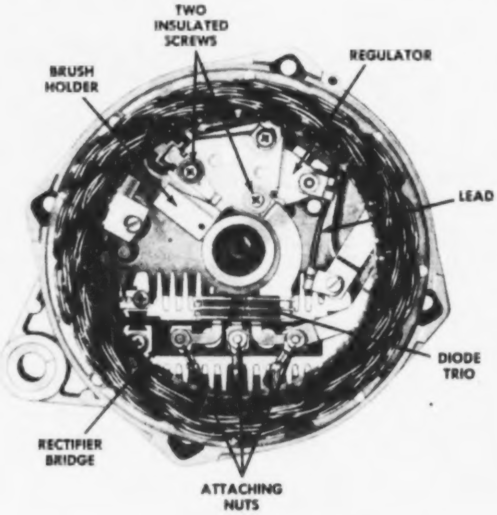

TWO INSULATED SCREWS
BRUSH HOLDER
REGULATOR
LEAD
DIODE TRIO
RECTIFIER BRIDGE
ATTACHING NUTS

Figure 7—Inside view end frame assembly. Negative ground.

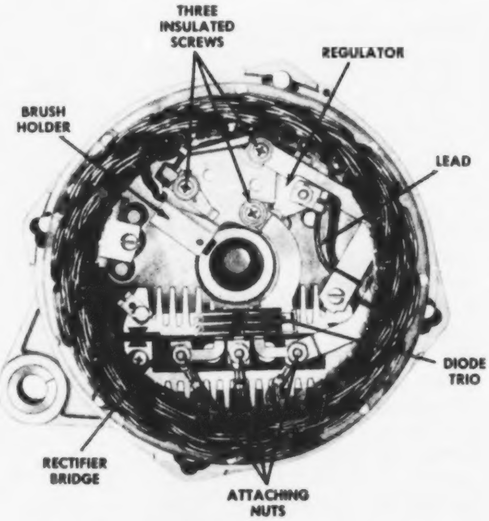

THREE INSULATED SCREWS
BRUSH HOLDER
REGULATOR
LEAD
DIODE TRIO
RECTIFIER BRIDGE
ATTACHING NUTS

Figure 8— Inside view end frame assembly. Positive ground.

3. With all accessories turned off, increase engine speed as required to obtain maximum voltage reading.

4. If voltage exceeds 15 volts on a 12-volt system, or 30 volts on a 24-volt system, remove Integral Charging System for repair as covered under heading of "INTEGRAL CHARGING SYSTEM REPAIR."

5. If voltage does not exceed the values listed in Step 4 preceding, adjust voltage to a lower value by removing voltage adjusting cap and re-inserting into connector body. Then check Energizer or battery condition after a service period of reasonable length, such as one week. Figure 5 is for purposes of illustration only, and shows the cap adjusted for medium high setting. The actual adjustment as shipped from the factory may be in some other position, depending on the application requirement. The lowest setting is with "LO" aligned with the arrow, position 2 is medium low, and "HI" is the highest setting.

INTEGRAL CHARGING SYSTEM REPAIR

To repair the Integral Charging System, observe the following procedure.

DISASSEMBLY

1. Remove four thru-bolts from drive end frame.

2. Separate slip ring end frame and stator assembly from drive end frame and rotor assembly.

3. Separate stator from end frame by removing three stator lead attaching nuts.

4. Place tape over bearing and shaft to protect from dirt. Use pressure sensitive tape and not friction tape that would leave a gummy deposit.

5. Inspect all leads for burned connections or opens, and brushes for excessive wear. Inspect springs for distortion or discoloration. Replace as required. Clean brushes with a soft dry cloth if they are to be reused. During servicing and reassembly hold brushes and springs in holder with a pin or toothpick inserted through end frame hole.

INSULATED SCREW CHECKS

Carefully inspect the regulator and brush holder mounting screws as shown in Figures 7 and 8. Note that on negative ground Integral Charging Systems two insulated and one grounded screw are used. On positive ground Integral Charging Systems, all three mounting screws are insulated. Damaged or missing insulators can cause damage to electrical components and improper charge to the Energizer.

DIODE TRIO CHECK

The diode trio is identified in Figures 7 and 8. To check the diode trio, remove it from the end frame assembly by detaching the nuts and attaching screw. Connect an ohmmeter having a 1½-volt cell, and using the low range scale to the single connector and to one of the three connectors (Fig. 9). Observe the reading. Then reverse the ohmmeter leads to the

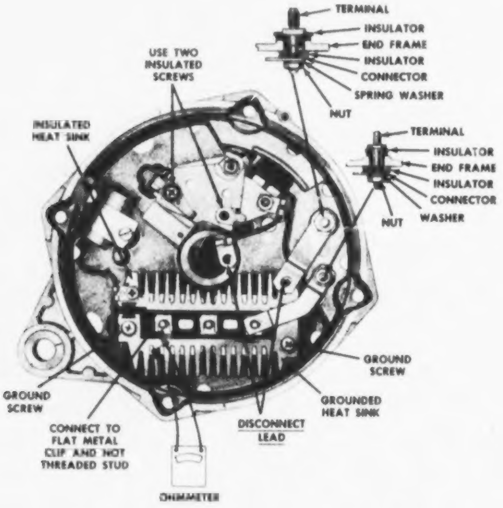

TERMINAL
INSULATOR
END FRAME
INSULATOR
CONNECTOR
SPRING WASHER
NUT
USE TWO INSULATED SCREWS
INSULATED HEAT SINK
TERMINAL
INSULATOR
END FRAME
INSULATOR
CONNECTOR
NUT
WASHER
GROUND SCREW
GROUNDED HEAT SINK
GROUND SCREW
CONNECT TO FLAT METAL CLIP AND NOT THREADED STUD
DISCONNECT LEAD
OHMMETER

Figure 10—Rectifier bridge check. Negative ground.

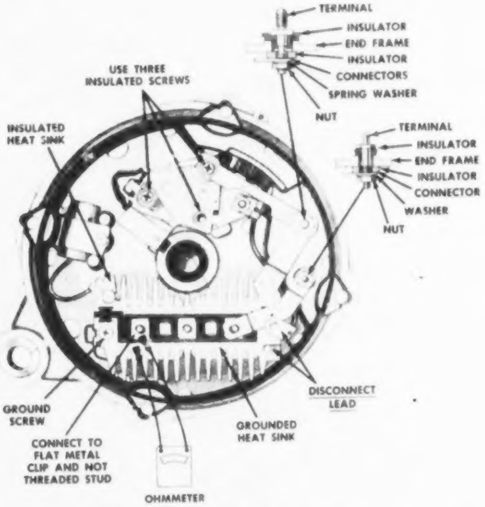

TERMINAL
INSULATOR
END FRAME
INSULATOR
CONNECTORS
SPRING WASHER
NUT
USE THREE INSULATED SCREWS
INSULATED HEAT SINK
TERMINAL
INSULATOR
END FRAME
INSULATOR
CONNECTOR
WASHER
NUT
DISCONNECT LEAD
GROUND SCREW
GROUNDED HEAT SINK
CONNECT TO FLAT METAL CLIP AND NOT THREADED STUD
OHMMETER

Figure 11—Rectifier bridge check. Positive ground.

same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors. NOTE: Diode trios differing in appearance may be specified for use in the same Integral Charging System, and the two are completely interchangeable.

RECTIFIER BRIDGE CHECK

(Omit for overcharged Energizer)

Note that the rectifier bridge has a grounded heat sink and an insulated heat sink (Figs. 10 and 11).

To check the rectifier bridge, connect the ohmmeter to a heat sink and one of the flat metal clips and not to threaded stud. Press down firmly onto flat metal clip. Then reverse lead connections. If both readings are the same, replace the rectifier bridge.

Repeat this same test between the same heat sink and other two metal clips and between the other heat sink and the three metal clips.

CAUTION: Do not use high voltage such as a 110 volt test lamp to check the rectifier bridge.

ROTOR FIELD WINDING CHECKS

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open (Fig. 12).

The winding is checked for short circuits or excessive resistance by connecting a battery and ammeter in series with the edges of the two slip rings. Note the ammeter reading and refer to Delco-Remy Service Bulletin 1G-187 for specifications. An ammeter reading above the specified value indicates shorted windings; a reading below the specified value indicates excessive resistance. If the winding is shorted, **replace the rotor, and the regulator** as covered in "BRUSH HOLDER AND REGULATOR REPLACEMENT" section.

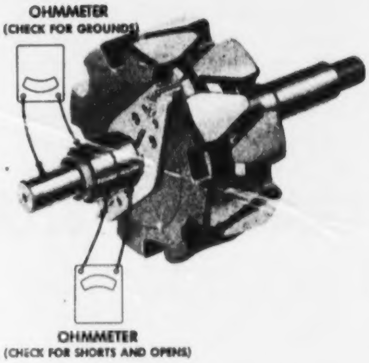


Figure 12—Checking rotor winding.

An alternate method is to check the resistance of the field by connecting an ohmmeter using low scale to the two slip rings (Fig. 12). If the resistance reading is below the specified value, the winding is shorted; if above the specified value the winding has excessive resistance. The specified resistance value can be determined by dividing the voltage by the current given in Bulletin 1G-187. Remember that the winding resistance and ammeter reading will vary slightly with winding temperature changes.

To check for grounds, connect ohmmeter as shown. Replace rotor if reading is less than infinite. Use low scale on ohmmeter.

STATOR CHECKS

(Omit for overcharged Energizer)

The stator windings may be checked for grounds with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to a clean metal part of the frame, the windings are grounded (Fig. 13). The delta windings cannot be checked for opens or for short circuits without laboratory test equipment. However, if all other electrical checks are normal and the generator fails to supply rated output, but will supply at least 10 amperes output, shorted stator windings are indicated.

REGULATOR CHECK

Since the regulator is completely enclosed, there is no practical way to check this unit with an ohmmeter. If none of the previous checks show any defects, and an undercharged condition was present, remove the connector body from the regulator and check with an ohmmeter using the middle-range scale as shown in Figure 14. Connect the ohmmeter to each adjacent pair of terminals, making four checks in all. If any one check is infinite, replace the connector body. The connector body need not be checked for an overcharged condition.

If all of the previous checks are satisfactory, replace the regulator provided that in the previous performance checks:

1. The system voltage was over 15 volts on a 12-volt system or over 30 volts on a 24-volt system.

BRUSH HOLDER AND REGULATOR REPLACEMENT

After removing the stator and diode trio, the brush holder and regulator may be replaced by removing the two remaining screws. Note the insulated screws in Figures 7 and 8.

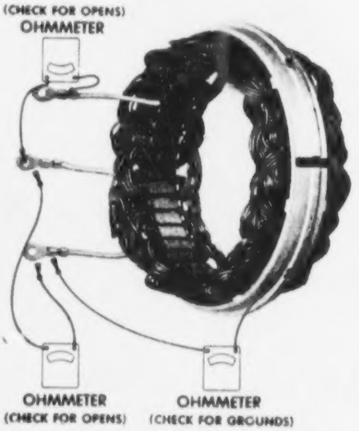


Figure 13—Checking stator windings.

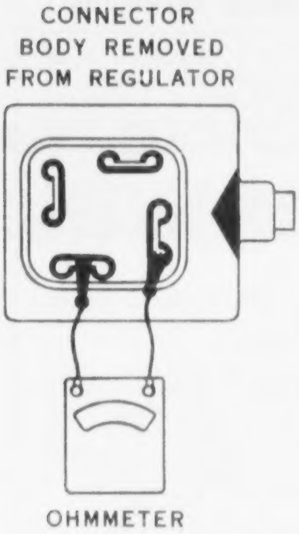


Figure 14—Checking connector body.

SLIP RING SERVICING

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and hold the polishing cloth against the slip rings until they are clean. CAUTION: The rotor must be rotated in order that the slip rings will be cleaned evenly.

Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

BEARING REPLACEMENT AND LUBRICATION (Fig. 2)

To replace the drive end bearing:

1. Remove shaft nut, pulley, fan and slinger.
2. Press rotor from end frame.
3. Remove retainer plate screws, retainer plate assembly, gasket and collar.
4. Press bearing from end frame.
5. Remove retainer plate and felt washer.
6. Install retainer plate and new felt washer.
7. Press bearing in with sealed side away from grease reservoir.
8. Fill grease cavity one-half full with Delco-Remy lubricant Part No. 1948791 and arrange the lubricant so a portion will touch the bearings after retainer plate attachment.
9. Attach gasket and retainer plate assembly to end frame, using new retainer plate assembly.
10. With collar on shaft, press rotor into end frame.
11. Assemble collar, slinger, fan, pulley and nut. Torque nut to 70-80 lb. ft.

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to relubricate and reuse the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside.

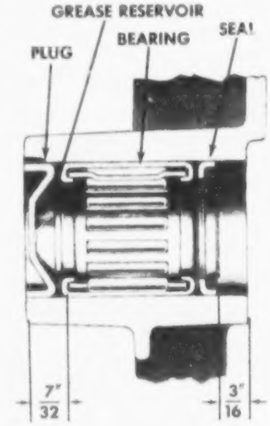


Figure 15—Slip ring end bearing and seal locations.

To install a new bearing, use the tube or collar to press the bearing in from the outside of the housing towards the inside to the dimension shown in Figure 15.

Fill the plug with No. 1948791 lubricant so that when pressed in flush with the end frame the grease reservoir will be half filled. Insure that some of the lubricant will be contacting the bearing when the plug is assembled. Use a new seal, and press in to the dimension shown in Figure 15. Coat the seal lip with the lubricant to facilitate assembly of the rotor shaft into the bearing.

REASSEMBLY

Reassembly is the reverse of disassembly.

To install the slip ring end frame assembly to the rotor and drive end frame assembly, remove the tape over the bearing and shaft, and make sure the shaft is perfectly clean after removing the tape. Insert a pin through the holes to hold up the brushes. Carefully install the shaft into the slip ring end frame assembly to avoid damage to the seal. After tightening the thru-bolts remove the brush retaining pin to allow the brushes to fall down onto the slip rings.

MAGNETIZING THE ROTOR

IMPORTANT: The rotor normally retains magnetism to provide voltage build-up when the engine is started. After disassembly or servicing, however, it may be necessary to reestablish the magnetism. To magnetize the rotor connect the Integral Charging System to the battery or Energizer in a normal manner, then momentarily connect a jumper lead from the **battery or Energizer positive post to the Integral Charging System relay terminal**, identified in Figure 1. This procedure will restore the normal residual magnetism in the rotor.

INTEGRAL CHARGING SYSTEM BENCH CHECK

The Integral Charging System may be checked on the bench for output by connecting an ammeter in the circuit (Fig. 4) and a voltmeter from the "BAT" terminal to ground, then following the procedures in the "TROUBLESHOOTING PROCEDURES" section.

IMPORTANT: Read the introductory paragraphs on page 3 before proceeding with either one of these sections.

UNDERCHARGED ENERGIZER

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions:

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery or Energizer defect is suspected, check per the applicable Delco-Remy Service Bulletin.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the cable clamps and Energizer posts.
5. Connect a voltmeter from "BAT" terminal to ground. A zero reading indicates an open between voltmeter connection and Energizer.
6. If previous Steps 1 through 5 check satisfactorily, check Integral Charging System as follows:
   a. Disconnect Energizer ground cable.
   b. Connect an ammeter in the circuit at the "BAT" terminal of the Integral Charging System.
   c. Reconnect Energizer ground cable.
   d. Turn on accessories. Connect a carbon pile across the Energizer.
   e. Operate engine at moderate speed as required, usually 4000 generator r.p.m. or more, and adjust carbon pile as required, to obtain maximum current output.

   IMPORTANT: Initial voltage build-up is by residual magnetism in the rotor. Increase the speed as required to obtain maximum current output.

If ampere output is not within 10 amperes of rated output as stamped on Integral Charging System frame, insert screwdriver into end frame hole to touch tab. On negative ground systems ground tab to end frame with screwdriver. On positive ground systems, connect voltmeter to metal screwdriver and Integral Charging System "BAT" terminal. If reading is battery voltage, replace rotor and regulator, as both are defective. If reading is not battery voltage, disconnect voltmeter and connect jumper lead from metal screwdriver to Integral Charging System "BAT" terminal (Fig. 6). Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.

If output is within 10 amperes of rated output, replace regulator as covered in "Integral Charging System Repair" section, and check field winding.

If output is not within 10 amperes of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in "Integral Charging System Repair" section.

If ampere output is within 10 amperes of rated output as stamped on frame, Integral Charging System is not defective. In this case, an adjustment of the voltage setting may correct the undercharged condition. Raise the setting by removing the voltage adjusting cap, rotating in increments of 90°, and then re-inserting the cap in the connector body as illustrated in Figure 5.

OVERCHARGED ENERGIZER

1. Check the battery or Energizer per the applicable Delco-Remy Service Bulletin. IMPORTANT — Remember that an overheated Energizer will be overcharged even though no charging circuit defects are present.
2. If Energizer or battery is not defective or overheated, connect a voltmeter between Integral Charging System "BAT" terminal and ground.
3. With all accessories turned off, increase engine speed as required to obtain maximum voltage reading.
4. If voltage exceeds 15 volts on a 12-volt system, or 30 volts on a 24-volt system, remove Integral Charging System for repair as covered under heading of "INTEGRAL CHARGING SYSTEM REPAIR."
5. If voltage does not exceed the values listed in Step 4 preceding, adjust voltage to a lower value by removing voltage adjusting cap and re-inserting into connector body as shown in Figure 5. Then check Energizer or battery condition after a service period of reasonable length, such as one week.

Bendix Drive

CRANKING MOTORS

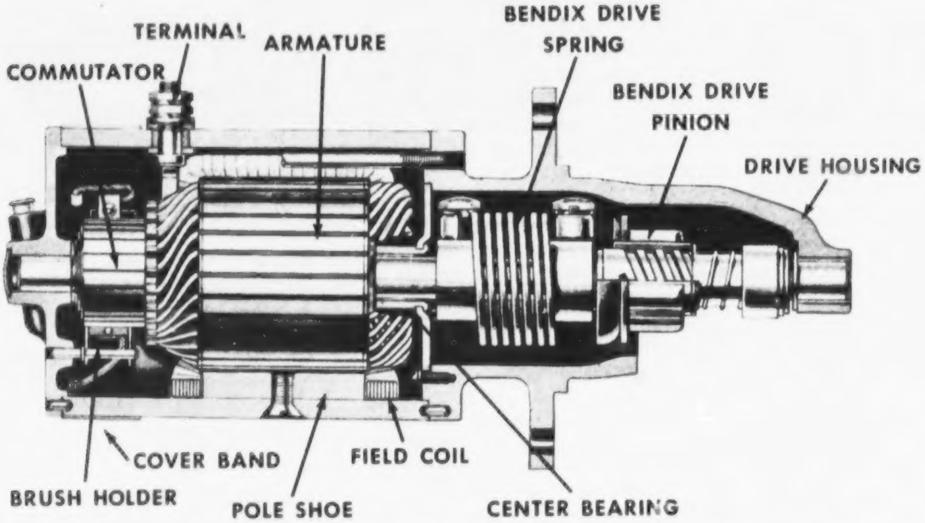


Figure 1—Sectional view of a standard Bendix drive cranking motor.

There are several types of Bendix drives used on cranking motors of different frame sizes. The function of the drive is to automatically engage the drive pinion with the engine flywheel ring gear to crank the engine, and to disengage the pinion from the ring gear when the engine starts. A typical motor is shown in Figure 1.

OPERATION

In Figure 2 is shown a basic cranking motor circuit. When the switch is closed, the magnetic switch winding is energized, and the switch contacts close to connect the motor directly to the battery. As the armature begins to rotate, the drive pinion, being a loose fit on the drive sleeve located on the armature shaft, does not pick up speed as fast as the armature. Therefore, the drive pinion, having internally matched splines with respect to the splined drive sleeve, moves endwise on the shaft and into mesh with the flywheel. As the pinion hits the pinion stop, it begins to rotate with the armature and cranks the engine.

When the engine starts, the flywheel begins to spin the pinion faster than the armature. Again, because of the splined action of the pinion and drive sleeve assembly, the pinion backs out of mesh with the flywheel ring gear protecting the armature from excessive speeds.

Some Bendix drives incorporate a small anti-drift spring between the drive pinion and the pinion stop which prevents the pinion from drifting into mesh when the engine is running. Others use a small anti-drift pin and spring inside the pinion which provides enough friction to keep the pinion from drifting into mesh.

Never operate the motor for more than 30 seconds without pausing for two minutes to allow it to cool.

CRANKING MOTOR LUBRICATION

Some motors do not require lubrication except during overhaul, whereas others are provided with lubrication fittings. If a means for lubricating is provided, the motor should be lubricated at periodic intervals as dictated by operating conditions.

1. Hinge cap oilers or oil tubes sealed with a pipe plug should have 8-10 drops of medium grade engine oil.
2. Grease cups should be turned down one turn. Refill if necessary with Delco-Remy Lubricant No. 1960954.

When the motor is disassembled for any reason, lubricate as follows:

1. Oil wicks, if present, should be resaturated.
2. Bushings should be coated with a

small amount of Delco-Remy Lubricant No. 1960954.

3. The armature shaft should be coated lightly with Delco-Remy Lubricant No. 1960954.
4. The drive assembly should be wiped clean and coated with light oil. Do not wash the drive assembly in solvent.
5. Avoid excessive lubrication.

TROUBLESHOOTING THE CRANKING CIRCUIT

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Battery: To determine the condition of the battery, follow the testing procedure outlined in Service Bulletin 7D-100 or 7D-100E. Insure that the battery is fully charged.

Wiring: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid or magnetic switch, ignition switch or any other control switch, and battery, including all ground connections. Clean and tighten all connections as required.

Magnetic Switch and Control Switches: Inspect all switches to determine their condition. Connect a jumper lead around any switch suspected of being defective. If the system functions properly using this method, repair or replace the bypassed switch.

Motor: If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

CRANKING MOTOR TESTS

With the cranking motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of operation by turning the pinion. Tight, dirty, or worn bearings, bent armature shaft, or a loose pole shoe screw will cause the armature to not turn freely. If the armature does not turn freely the motor should be disassembled immediately. However, if the armature does operate freely, the motor should be given electrical tests before disassembly.

No-Load Test (Fig. 3)

Connect a voltmeter from the motor terminal to the motor frame, and use an r.p.m. indicator to measure armature speed. Connect the motor, switch and an ammeter in series with a fully charged battery of the specified voltage and compare the r.p.m., current, and voltage readings with the specifications in Service Bulletins 1M-180, 1M-185, 1M-186, or 1M-187. It is not necessary to obtain the exact voltage specified in these bulletins, as an accurate interpretation can be made by recognizing that if the voltage is slightly higher the r.p.m. will be proportionately higher, with the current remaining essentially unchanged. However, if the exact voltage is desired, a carbon pile connected across the battery can be used to reduce the voltage to the specified value. Interpret the test results as follows:

1. Rated current draw and no-load speed indicate normal condition of the cranking motor.
2. Low free speed and high current draw indicate:
   a. Too much friction—tight, dirty, or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.
   b. Shorted armature. This can be further checked on a growler after disassembly.
   c. Grounded armature or fields. Check further after disassembly.
3. Failure to operate with high current draw indicates:
   a. A direct ground in the terminal or fields.
   b. "Frozen" bearings (this should have been determined by turning the armature by hand).
4. Failure to operate with no current draw indicates:
   a. Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.

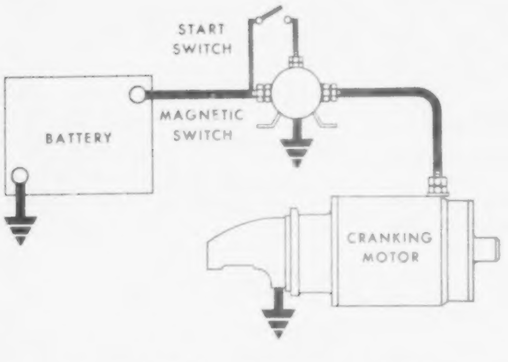


Figure 2—Basic cranking motor circuit.

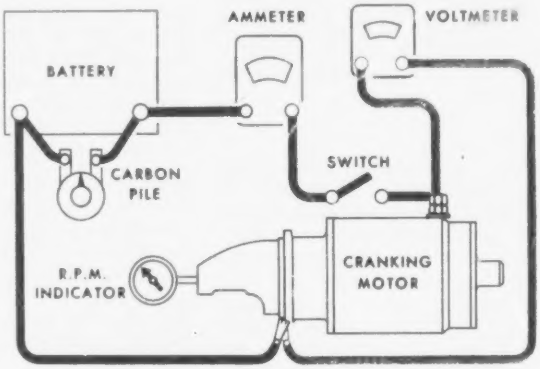


Figure 3—Circuit for no-load test.

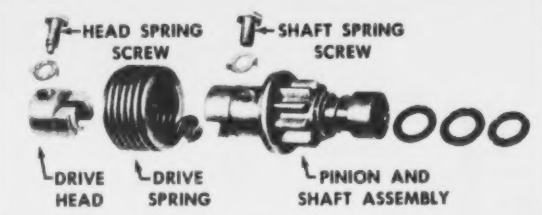

HEAD SPRING SCREW
SHAFT SPRING SCREW
DRIVE HEAD
DRIVE SPRING
PINION AND SHAFT ASSEMBLY

Figure 4

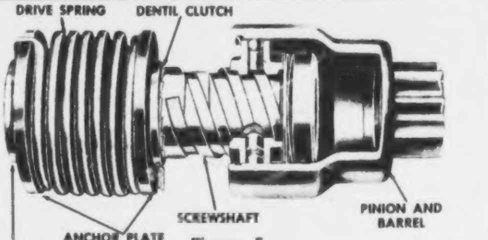

DRIVE SPRING
DENTIL CLUTCH
SCREWSHAFT
PINION AND BARREL
ANCHOR PLATE
DRIVE HEAD

Figure 5

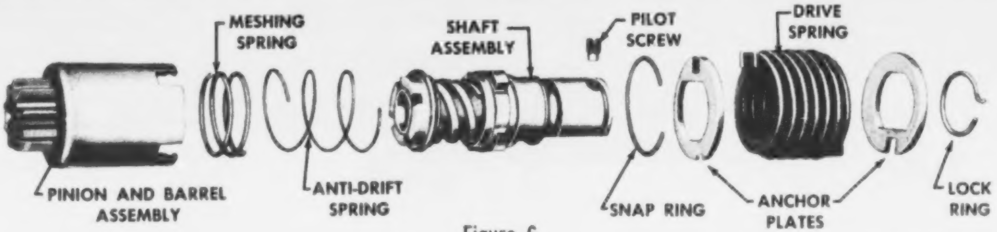
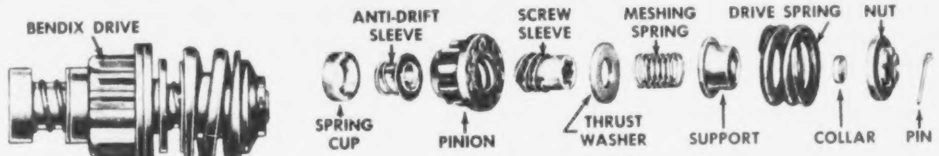

MESHING SPRING
SHAFT ASSEMBLY
PILOT SCREW
DRIVE SPRING
PINION AND BARREL ASSEMBLY
ANTI-DRIFT SPRING
SNAP RING
ANCHOR PLATES
LOCK RING

Figure 6


BENDIX DRIVE
ANTI-DRIFT SLEEVE
SCREW SLEEVE
MESHING SPRING
DRIVE SPRING
NUT
SPRING CUP
PINION
THRUST WASHER
SUPPORT
COLLAR
PIN

EXPLODED VIEW OF DRIVE

Figure 7

   b. Open armature coils. Inspect the commutator for badly burned bars after disassembly.
   c. Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

5. Low no-load speed and low current draw indicate:
   a. High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Number 4.

6. High free speed and high current draw indicate shorted fields. If shorted fields are suspected, replace the field coil assembly and check for improved performance.

DISASSEMBLY

If the motor does not perform in accordance with published specifications, it may need to be disassembled for further testing of the components. Normally the cranking motor should be disassembled only so far as is necessary to make repair or replacement of the defective parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the cranking motor. Following are general instructions for disassembling a typical Bendix drive cranking motor:

1. Remove the magnetic switch, if present.

2. Remove the cover band, if present, and detach the field coil leads from the brush holders.

3. If gear reduction, remove the drive housing, and reduction housing.

4. Remove the bolts attaching the drive housing and commutator end frame to the field frame assembly. Discard the tang lock washers.

5. Separate the commutator end frame, armature assembly, field frame, and drive housing.

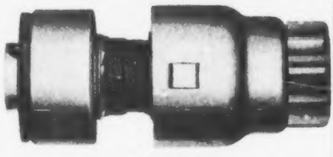


Figure 8

6. Remove and disassemble the drive from the armature shaft by first identifying the type Bendix drive and then following **one** of the guides below:
   a. Standard Bendix Drive, Figure 4. Remove the head spring screw and slip it off of the armature shaft.
   b. Folo-Thru-Bendix Drive, Figure 5. Push in the outer anchor plate so the pilot screw or pin can be removed. NOTE: Some Folo-Thru Drives use a rubber cushion in place of a drive spring. To remove from shaft, screw pinion out to drive position, then force pin from

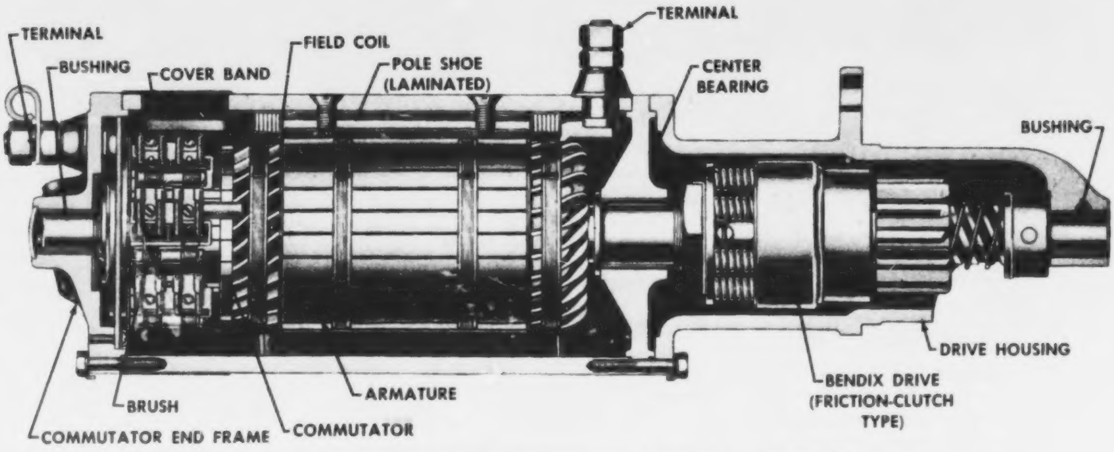

TERMINAL
BUSHING
COVER BAND
FIELD COIL
POLE SHOE (LAMINATED)
TERMINAL
CENTER BEARING
BUSHING
DRIVE HOUSING
BENDIX DRIVE (FRICTION-CLUTCH TYPE)
ARMATURE
BRUSH
COMMUTATOR END FRAME
COMMUTATOR

Figure 9—Heavy duty cranking motor using a friction-clutch Bendix drive.

shaft through screw sleeve holes. CAUTION: Do not disassemble this drive, service is by complete replacement (Fig. 8).

c. Barrel Bendix Drive, Figure 6. Push in the outer anchor plate so the pilot screw or pin can be removed.
d. Compression Spring Bendix Drive, Figure 7. Remove the cotter pin, unscrew nut and remove parts as shown.
e. Friction Bendix Drive, Figure 9. Release the head screw lock ring and remove the screw. Rotate the clutch spring assembly if one of the springs obstructs the head screw. Pull the drive from the armature shaft.

COMPONENT INSPECTION AND REPAIR

A. Brushes and Brush Holders—Inspect the brushes for wear. If they are excessively worn when compared with a new brush, they should be replaced. Make sure the brush holders are clean and the brushes are not binding in the holders. The full brush surface should ride on the commutator to give proper performance. Check by hand to insure that the brush springs are giving firm contact between the brushes and commutator. If the springs are distorted or discolored, they should be replaced.

B. Armature—If the commutator is excessively worn, dirty, out of round, or if it has high insulation, it should be turned down in a lathe and the insulation undercut 1/32" wide and 1/32" deep. IMPORTANT: Do not undercut insulation on motors having Test Specifications 3501 and 3564 as listed in Delco-Remy Service Bulletins 1M-186 and 1M-187, or on motors having commutators with the flat molded core construction in place of the metal V-ring core construction.

The armature should be checked for short circuits, opens, and grounds:

1. Short circuits are located by rotating the armature in a growler with a steel strip such as a hacksaw blade held on the armature. The steel strip will vibrate on the area of the short circuit. Shorts

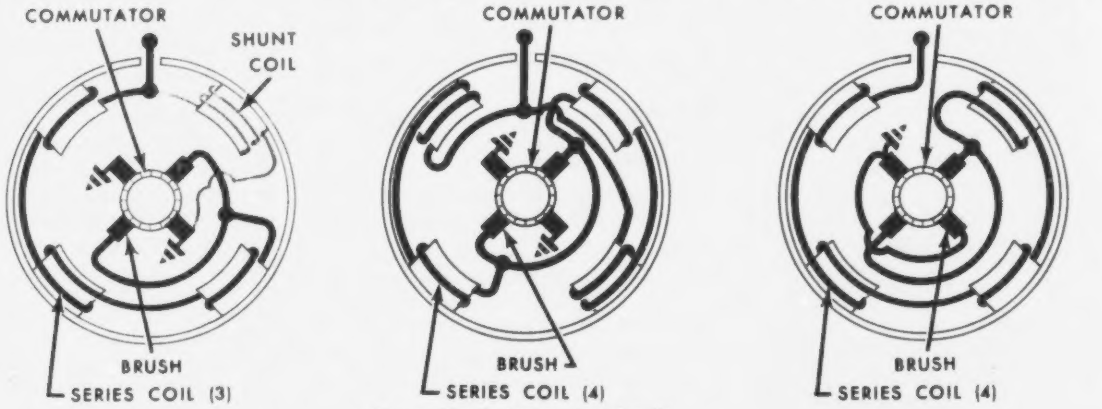
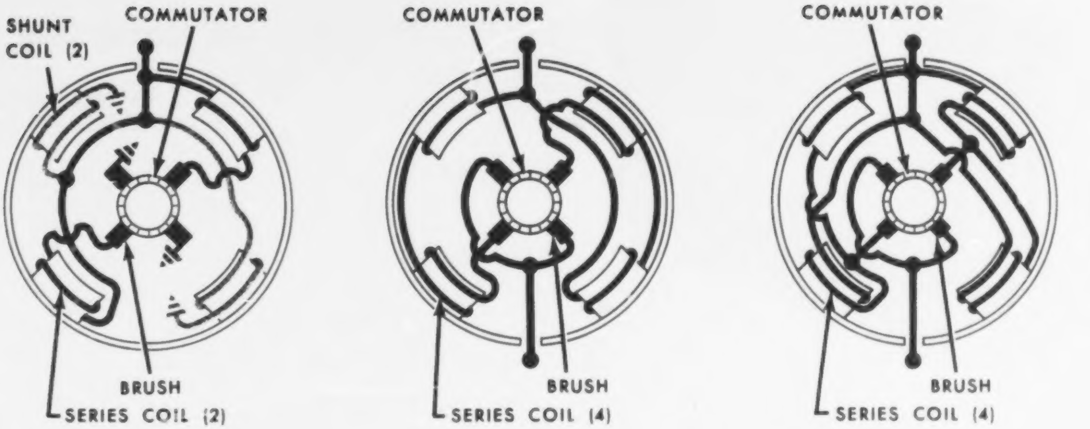

COMMUTATOR
SHUNT COIL
BRUSH
SERIES COIL (3)
COMMUTATOR
BRUSH
SERIES COIL (4)
COMMUTATOR
BRUSH
SERIES COIL (4)

Figure 10—Typical motor circuits.



between bars are sometimes produced by brush dust or copper between the bars. Undercutting the insulation will eliminate these shorts.

2. Opens—Inspect the points where the conductors are joined to the commutator for loose connections. Poor connections cause arcing and burning of the commutator. If the bars are not badly burned, leads originally soldered to the riser bars can be resoldered.
3. Grounds in the armature can be detected by the use of a test lamp and prods. If the lamp lights when one test prod is placed on the commutator and the other test prod on the armature core or shaft, the armature is grounded. If the commutator is worn, dirty, out of round, or has high insulation, the commutator should be turned down and undercut as previously described.

C. Field Coils—The field coils should be checked for grounds and opens using a test lamp. Typical circuits are shown in Figures 10 and 11.

1. Grounds — Disconnect field coil ground connections. Connect one test prod to the field frame and the other to the field connector. If the lamp lights, the field coils are grounded and must be repaired or replaced.
2. Opens—Connect test lamp prods to ends of field coils. If lamp does not light, the field coils are open.

If the field coils need to be removed for repair or replacement, a pole shoe spreader and pole shoe screwdriver should be used. Care should be exercised in replacing the field coils to prevent grounding or shorting them as they are tightened into place. Where the pole shoe has a long lip on one side, it should be assembled in the direction of armature rotation.

REASSEMBLY

To reassemble the motor follow the disassembly procedures in reverse. Install new tang lock washers where removed.

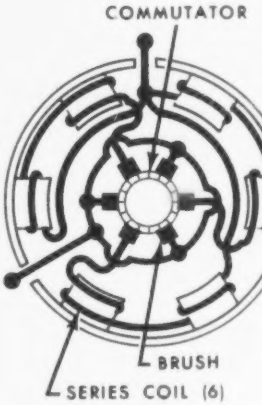


Figure 11—Typical motor circuits.

CAUTION: If Folo-Thru drive is manually rotated to locked position, do not attempt to force it in a reverse direction. Proceed to install with pinion meshing with flywheel. When engine starts, the drive will return to the demeshed position.

NOTES

Care, Maintenance and Testing of

BATTERIES

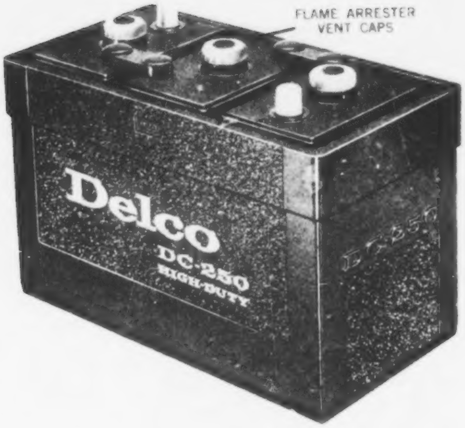

FLAME ARRESTER
VENT CAPS
Delco
DC-250
HIGH-DUTY

Figure 1—Typical DC-250 battery with flame arrester vent caps.

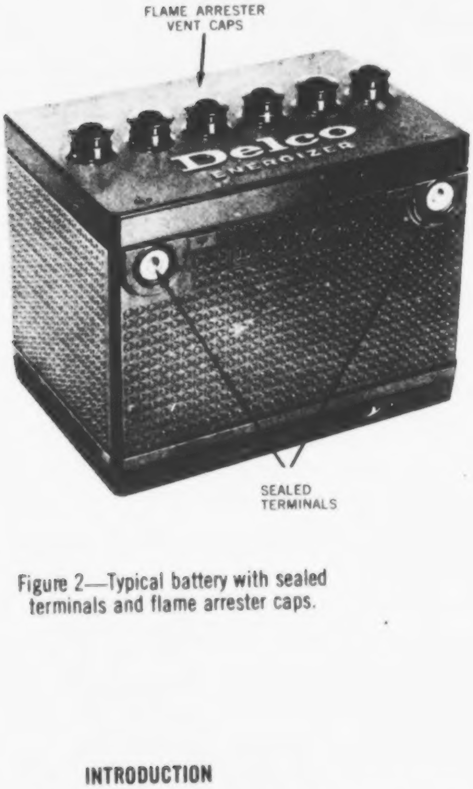

FLAME ARRESTER
VENT CAPS
Delco
ENERGIZER
SEALED
TERMINALS

Figure 2—Typical battery with sealed terminals and flame arrester caps.

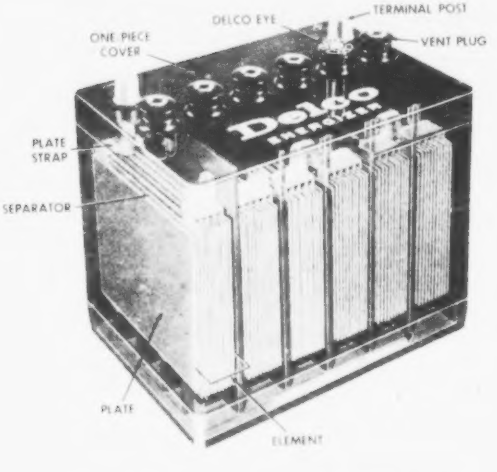

DELCO EYE
TERMINAL POST
ONE PIECE
COVER
VENT PLUG
PLATE
STRAP
SEPARATOR
PLATE
ELEMENT
Delco
ENERGIZER

Figure 3—Phantom view of typical battery with Delco Eye.

INTRODUCTION

The batteries illustrated are typical of the many different types and designs made by Delco-Remy. Some batteries are called Energizers. Basically, all batteries are the same and are made up of positive and negative plates held apart by separators.

Each group of plates is immersed in a separate cell in a solution of electrolyte (dilute sulfuric acid). The groups are connected in series and each plate group or cell produces about two volts. Thus, a six-cell battery is a 12-volt battery.

Batteries with flame arrester caps prevent internal explosions from an external spark or flame (Fig. 1 and Fig. 2). Batteries without flame arrester caps have a Delco Eye to indicate the electrolyte level. (covered in a later section).

Care, Maintenance and Testing of BATTERIES

TYPES OF BATTERIES

There are two types of batteries: "dry charge" and "wet charge." The difference depends on the method of manufacture.

DRY CHARGED BATTERIES—A Delco "dry charge" battery contains plates which have been thoroughly charged, washed and dried. It contains no electrolyte when it leaves the factory, so it is called a "dry charge" battery.

Most vent wells in a dry charge battery have a seal to keep out air and moisture. See Figure 4. The seals and the sealing compound on most batteries between the case and one-piece cell cover make a vacuum sealed assembly which can be stored for very long periods of time without deterioration.

Before adding electrolyte to the dry charge battery, the seals are broken by pushing the Delco Eye or vent plug down into each vent well. The seals drop harmlessly into the cells and remain there. (The Delco Eye is a special type of vent plug that is described in the section entitled **Periodic Servicing.**)

WET CHARGED BATTERIES—Delco wet charged batteries contain fully charged plates and are filled with electrolyte before being shipped from the factory.

SPECIFIC GRAVITY READINGS

As the battery is discharged, the sulfuric acid in the electrolyte combines with the material making up the plates. This removes the acid so the electrolyte more nearly becomes pure water. This means there is a relation between state of charge and the specific gravity reading. The lower the specific gravity, the lower the battery state of charge.

A hydrometer can be used to measure the specific gravity of the electrolyte in each cell. A fully charged battery will have a specific gravity reading of approximately 1.270 at an electrolyte temperature of 80°F. If the electrolyte temperature is above or below 80°F, additions or subtractions must be made in order to obtain a hydrometer reading corrected to the 80°F standard. For every 10° above 80°F, add four specific gravity points (.004) to the hydrometer reading. Example: A hydrometer reading of 1.260 at 110°F would be 1.272 corrected to 80°F (30° difference ÷ 10 = 3 × .004 = .012. Add this to 1.260 = 1.272), indicating a fully charged battery. For every 10° below 80°F, subtract four points (.004) from the reading. Example: A hydrometer reading of 1.272 at 0°F would be 1.240 corrected to 80°F (80° difference ÷ 10 = 8 × .004 = .032. Subtract this from 1.272 = 1.240), indicating a partially charged battery.

BATTERY FREEZING

The freezing point of electrolyte depends on its specific gravity. The following table gives the freezing temperatures of electrolyte at various specific gravities:

Value of Specific Gravity Corrected to 80°F	Freezing Temp. Deg. F	Value of Specific Gravity Corrected to 80°F	Freezing Temp. Deg. F
1.100	18	1.220	—31
1.120	13	1.240	—50
1.140	8	1.260	—75
1.160	1	1.280	—92
1.180	—6		
1.200	—17		

Since freezing may ruin a wet battery it should be protected by keeping it in a charged condition. This is true whether the wet battery is in storage or in service. **Never add antifreeze** to the battery to prevent freezing.

BATTERY STORAGE

"DRY CHARGE" TYPE — Since the dry charge battery is vacuum sealed, it can be stored for long periods of time, so long as the seals remain unbroken. However, the following should be noted:

1. Keep the battery in its shipping carton.
2. Do not stack "dry charge" batteries in cartons more than four high.
3. Rotate stocks regularly.
4. Maintain the storage area at 60°F or higher.

"WET CHARGE" TYPE—A wet charged battery will not maintain its charged condition during storage, and must be recharged periodically. During storage, a slow chemical reaction takes place inside the battery which causes it to lose charge. This is called "self-discharge." The rate at which self-discharge occurs varies directly with temperature of the electrolyte.

Note from Figure 5 that a battery stored at 100°F for 60 days has a much lower specific gravity and state of charge than one stored at 60°F for the same length of time.

To reduce self-discharge, wet batteries should be stored in as cool a place as possible, provided the electrolyte does not freeze.

A wet battery which has been idle for a long period of time without recharging may become so badly sulfated it can never be restored to a normal charged condition. A battery in this condition loses its capacity and is hard to charge. These changes prevent satisfactory performance in a vehicle.

Periodic recharging is necessary for wet charged batteries in storage.

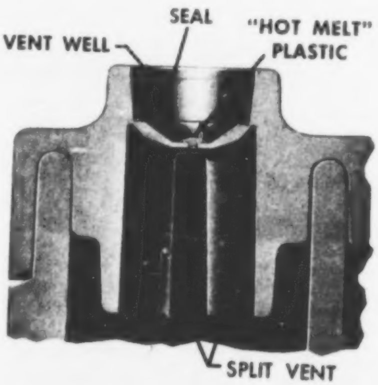


Figure 4—Typical vent well construction showing seal.

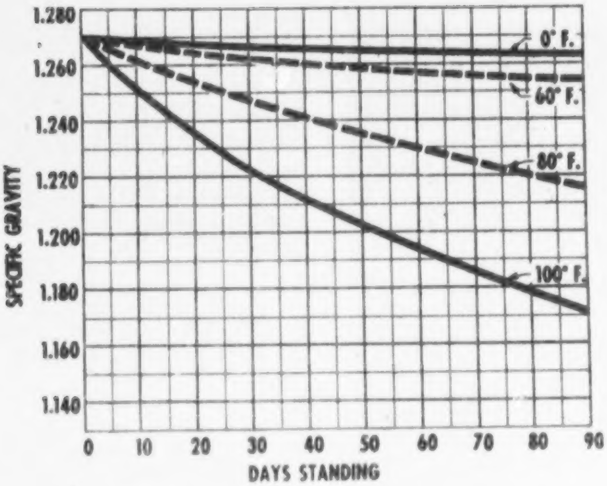


Figure 5—Chart showing rate of self-discharge at various temperatures.

CHARGING WET BATTERIES IN STORAGE

The battery should be fully charged every 30 days, as covered under the heading of "**Battery Charging.**"

Trickle charging should not be used to keep batteries in a charged condition when in storage. Charging at a low charge rate every 30 days is best for maintaining wet charged batteries in a fully charged condition without damage.

ACTIVATING DRY CHARGED BATTERIES

A "dry charge" battery is activated by filling each cell with electrolyte, which is a dilute solution of sulfuric acid having a specific gravity of 1.265 at 80°F. Under certain conditions a slightly lower specific gravity may be specified. The cells are properly filled when the electrolyte level reaches the bottom of the "split vent" at the bottom of the vent well. The split vent is a visual level feature in the cell cover of Delco batteries (Fig. 4). The electrolyte surface will appear distorted when it contacts the split vent (Fig. 6).

The electrolyte level of each cell should be checked after filling the battery the first time. If the level has fallen below the split vent, more electrolyte should be added. NEVER ADD WATER TO THE ELECTROLYTE WHEN ACTIVATING A BATTERY.

Long and trouble-free service comes only if the battery is properly activated. Improper activation results in poor performance and short life.

PERIODIC SERVICING

Since the battery is a perishable item which requires periodic servicing, a good maintenance program will insure the longest possible life.

DELCO-EYE—The Delco Eye is a specially designed vent plug with a transparent rod extending through the center. When the electrolyte is at the proper level, the lower tip of the rod is covered and the exposed top of the rod appears very dark (Fig. 7). When the level falls below the tip of the rod, the top will glow (Fig. 8). The Delco Eye reveals at a glance if water is needed without removing the vent plugs. It is used in only one cell because when the electrolyte level is low in one cell, it is normally low in all cells. When the Delco Eye indicates water is needed, check the level in all six cells.

An alternate method is to remove the vent plug and observe the electrolyte level in the vent well. The bottom of the well is split which causes the surface of the electrolyte to appear distorted when it makes contact. The electrolyte level is correct when the distortion first appears (Fig. 6).

ELECTROLYTE LEVEL — The electrolyte level in the battery should be checked regularly. In hot weather, particularly during trip driving, checking should be

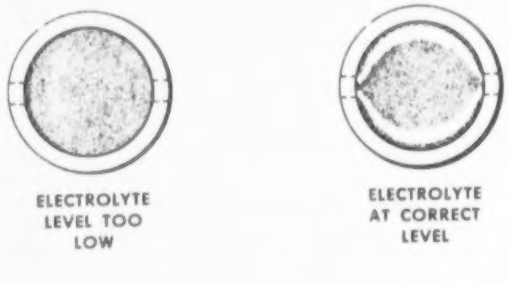


Figure 6—View inside vent well showing electrolyte.

more frequent because of more rapid loss of water. If the electrolyte level is found to be low, then colorless, odorless drinking water should be added to each cell until the liquid level rises to the split in the bottom of the vent well.

DO NOT OVERFILL—This will cause loss of electrolyte, resulting in poor performance, short life and excessive corrosion. During service, only water should be added to the battery, not electrolyte.

The liquid level in the cells should never be allowed to drop below the top of the plates. That portion of the plates exposed to air may be permanently damaged with resulting loss in performance.

WATER USAGE—Excessive use of water indicates the battery is being overcharged. The most common causes of overcharge are high battery operating temperatures or too high a voltage regulator setting. Normal water usage is approximately one to two ounces per month per battery.

VISUAL INSPECTION—Look for cracked cover, case or vent plugs that could permit electrolyte leakage.

CLEANING—The external condition of the battery should be checked periodically for the presence of dirt and corrosion. The top should be kept clean on post type batteries. Acid film and dirt permit current to flow between the posts which will slowly discharge the battery. For best results when cleaning the top of batteries, wash first with a diluted ammonia or a soda solution to neutralize any acid present; then flush with clean water. Care must be taken to keep vent plugs tight so that the solution does not enter the cells.

CABLES—To insure good electrical contact, the cables should be clean and tight on the battery posts. If the posts or cable terminals are corroded, the cables should be disconnected and the terminals and clamps cleaned separately with a soda solution and a wire brush. After cleaning and connecting the cables, apply a thin coating of petroleum jelly on the post and cable clamps to retard corrosion.

The cable connector used with sealed terminal battery seals the connection and makes a permanently tight and clean connection. Stud tightness should be 70 lb.-in. No coating of grease or petroleum should be used.

CARRIER AND HOLD-DOWN—The battery carrier and hold-down should be free from corrosion before installing the battery. The carrier should be in sound mechanical condition so that it will support the battery securely and keep it level.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tight. However, the bolts should not be tightened to the point where the battery case or cover will be under a severe strain.

The hold-down bolts should be torqued to 60-80 lb.-in. for bottom recess type and 40-60 lb.-in. for top bar and frame types.

HANDLING—Lifting tools are available for carrying batteries. The type that grasps the case is preferred. The battery case should be grasped on the sides and not the ends. This permits pressure to be transferred to the cell partitions and prevents case flexing. Movement of the case under the lifting tool pads could cause dangerous slippage of the battery from the tool.

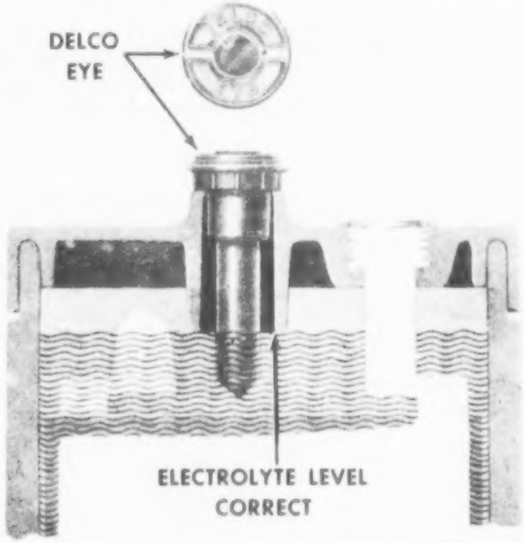


Figure 7—Typical cut-away view showing electrolyte at proper level, with Delco Eye having dark appearance.

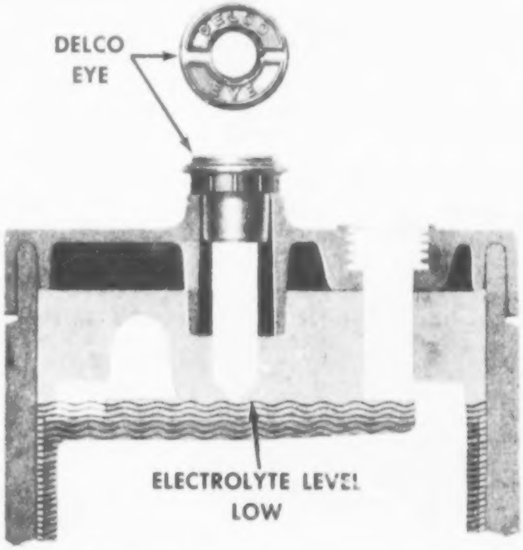


Figure 8—Typical cut-away view showing electrolyte at low level, with Delco Eye having light appearance.

BATTERY SAFETY PRECAUTIONS

When working with batteries, use extreme care to avoid spilling or splashing electrolyte. The electrolyte can destroy clothing and cause body burns. If electrolyte is spilled or splashed on clothing or body, it should immediately be neutralized with a solution of baking soda and water and then rinsed with clean water.

Electrolyte splashed into the eyes is extremely hazardous. Safety glasses should be worn when working with batteries. If electrolyte is splashed into the eye, force the eye open and flood it with cool clean water for about five minutes and call a doctor immediately. Do not add eye drops or other medication unless advised by the doctor.

If electrolyte is spilled or splashed on painted or unpainted metal surfaces of a vehicle, it should be neutralized with the baking soda solution and rinsed with clean water.

When batteries are being charged, an explosive gas mixture forms in each cell. Part of this gas escapes through the holes in the vent plugs and may form an explosive atmosphere around the battery if ventilation is poor. This explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion which may shatter the battery (Fig. 9). The following precautions should be observed to prevent an explosion:

1. Do not smoke near batteries being charged or which have been very recently charged.
2. Do not break live circuits at the terminals of batteries because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting booster leads or cable clamps on chargers. Poor connections are a common cause of electrical arcs which cause explosions.

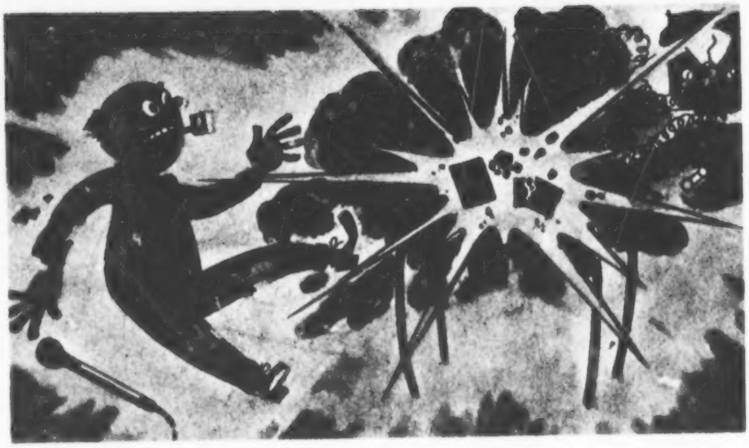


Figure 9—Sparks or flames near a battery may ignite explosive gases causing an explosion.

BATTERY CHARGING

Battery charging consists of applying a charge rate in amperes for a period of time in hours. Thus, a 10-ampere charge rate for seven hours would be a 70 ampere-hour (A.H.) charge to the battery.

Charging rates in the 3 to 50 ampere range are generally satisfactory. Specific charging rates or times cannot be specified for batteries, due to the following:

1. The size or electrical capacity in ampere-hours (A.H.) of the battery—Example: A completely discharged 70 A.H. battery requires almost twice the recharging as a 40 A.H. battery.
2. Temperature of the electrolyte—Example: About two hours longer will be needed to charge a battery at 0°F than at 80°F.
3. Battery state of charge at the start of the charging period—Example: A completely discharged battery requires twice as much charge in ampere-hours as a one-half charged battery.
4. Battery age and condition—Example: A battery that has been subjected to severe service will require up to 50% more ampere-hour charging than a relatively new battery.

The following basic rule applies to any battery charging situation:

Any battery may be charged at any rate above three amperes for as long as spewing of electrolyte, due to violent gassing, does not occur, and for as long as electrolyte temperature does not exceed 125°F. If spewing of electrolyte occurs, or if electrolyte temperature exceeds 125°F, the charging rate in amperes must be reduced or temporarily halted to avoid damage to the battery.

The battery is fully charged when, after two hours at a low charging rate and all cells are gassing freely (not spewing liquid electrolyte), no change in specific gravity occurs. The full charge specific gravity is 1.260-1.280, corrected for electrolyte temperature with the electrolyte level at the split ring. If electrolyte loss has occurred due to age or overfilling, the specific gravity reading will be lower. For the most satisfactory charging, the lower charging rates in amperes are recommended.

If after prolonged charging, a specific gravity of at least 1.230 on all cells cannot be reached, the battery will not perform like new, but it may continue to provide additional service if it has performed satisfactorily in the past.

An "emergency boost charge" consisting of a high charging rate for a short period of time may be used to crank an engine. However, this procedure usually supplies insufficient battery reserve to crank a second and third time. Therefore, the "emergency boost charge" must be followed by later charging to restore the battery to a satisfactory state of charge. A charging guide is shown on page 12.

When out of the vehicle, the battery with sealed terminals requires adapters for the terminals to provide a place for attaching the charging leads. See Fig. 10.

When the sealed terminal battery is in the vehicle, the studs provided in the wiring harness are suitable for connecting the charger's leads.

After charging has been completed, add water to adjust the electrolyte level to the bottom of the split vent.

NOTE: During charging remove non-flame arrester vent caps and lay a cloth over the vent holes. Leave flame arrester vent caps in place during charging.

BATTERY TESTING PROCEDURE

To determine the ability of a battery to function properly requires testing. A testing procedure is used to determine whether the battery is (1) good and usable, (2) requires recharging or (3) is worn out and should be replaced. The accuracy of the testing is dependent upon such variables as temperature, specific gravity, age of the battery, etc. Therefore, an accurate test has more than one step. The recommended testing procedure for the battery is:

Step 1.—Visual Inspection
Step 2.—Specific Gravity Test
Step 3.—Load Test

WARNING: When testing batteries, wear safety glasses. If battery has been on charge or is being charged during the test procedure, blow away gases before continuing testing. Do not break electrical circuits near the battery top as a spark could start an explosion.

Step 1.—VISUAL INSPECTION

A. Check for obvious damage, such as a cracked or broken case that could permit loss of electrolyte. If obvious physical damage is noted, replace battery.

B. If no damage is noted, check electrolyte level. If level is above the top of the plates in all cells, proceed to Step 2.

C. If no damage is noted and electrolyte level is below the top of plates in one or more cells, add water to bring level to top of separators sufficient to take hydrometer readings but not to split ring in all cells. Remove non-flame arrester caps but leave flame arrester caps in place. Then charge battery for 15 minutes at a 15 to 25 ampere rate to mix the electrolyte and water.

Step 2.—SPECIFIC GRAVITY TEST

Take a hydrometer reading of each cell. If there are 50 points (.050) or more variation between the highest and lowest cell, replace battery. If there is less than 50 points variation, proceed to Step 3.

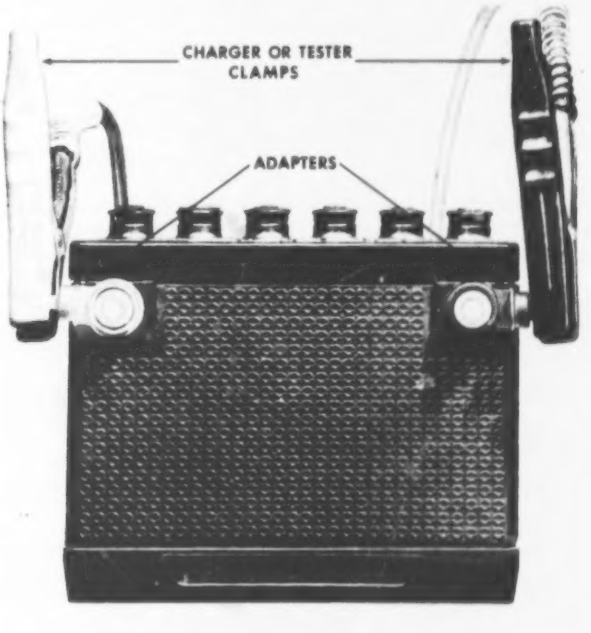


Figure 10—Battery/ST adapters

Step 3.—LOAD TEST

The Load Test cannot be applied to a battery unless the battery is in a sufficient state-of-charge to be tested. To place a heavy electrical load on a discharged battery as a part of a test procedure would condemn the battery because of its discharged condition. Therefore, no battery can be expected to qualify for a Load Test unless its specific gravity is at least 1.200 @ 80°F (1.230 for R-87, Y-87, R-86P, Y-86P and all W and Z series batteries).

Charge the battery, if necessary, until all cells are at least 1.200 specific gravity @ 80°F or more (1.230 for R-87, Y-87, R-86P, Y-86P and all W and Z series batteries). If charging will not bring the specific gravity up to 1.200 @ 80°F in all cells, replace the battery (1.230 for R-87, Y-87, R-86P, Y-86P and all W and Z series batteries).

Batteries over 1.200 specific gravity @ 80°F should quickly be tested for internal shorts (1.230 for R-87, Y-87, R-86P, Y-86P and all W and Z series batteries). Remove vent caps and connect a 300 ampere load for 15 seconds across the battery terminals. If a blue haze or "smoke" is seen in one or more cells, replace battery. If no "smoke" is noted, proceed with Load Test as follows:

A. Since the battery's ability to deliver current is affected by temperature, a thermometer should be placed in one cell.

B. Connect and apply the load specified in Delco-Remy Specification Bulletin 1B-187. This is approximately 3 times the ampere-hour rating for 12-volt batteries and 2 times the ampere-hour rating for 6-volt batteries.

C. Read terminal voltage at end of 15 seconds with the load still connected. Do not keep load attached for a longer period of time before reading the voltage as this would alter the test results and be apt to condemn many good batteries.

D. Remove load at the end of 15 seconds and note the electrolyte temperature. Then compare the voltage and temperature readings with the chart shown below and proceed as follows:

ELECTROLYTE TEMPERATURE—F	12-VOLT MINIMUM VOLTAGE	6-VOLT MINIMUM VOLTAGE
80° (or above)	9.6	4.8
70°	9.6	4.8
60°	9.5	4.7
50°	9.4	4.7
40°	9.3	4.6
30°	9.1	4.5
20°	8.9	4.4
10°	8.7	4.3
0°	8.5	4.2

1. If terminal voltage drops below the minimum listed above at the given temperature when a battery is subjected to the proper load for 15 seconds and is 1.200 specific gravity @ 80°F or more, replace battery (1.230 for R-87, Y-87, R-86P, Y-86P and all W and Z series batteries).
2. If terminal voltage is the same or greater than the minimum listed above at the given temperature and proper load, the battery is capable of further service. For best results, clean and fully charge battery before returning to service.

BATTERY TROUBLESHOOTING

If the battery tests good but fails to perform staisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of the trouble.

1. Vehicle accessories left on overnight cause a discharged condition.
2. Slow speed driving or drives of short duration causing an undercharged condition.
3. Improper voltage regulator setting for owner's driving habits.
4. A vehicle electrical load exceeding the generator's capacity.
5. Improper charging system diagnosis.
6. Battery abuse, including failure to keep the battery top clean, cable clamps and post clean and tight, and improper addition of water to the cells.
7. Failure to charge the battery properly, as covered in the section entitled, "Battery Charging."

SELECTING A REPLACEMENT BATTERY

Long and troublefree service can be more assured when the capacity or watt rating of the replacement battery is at least equal to the rating of the battery originally engineered for the application. The watt rating of batteries is a measure of its ability to supply high cranking power to the cranking motor at 0°F temperatures.

The use of an undersize battery may result in poor performance and early failure. Figure 11 shows how battery power shrinks while the need for engine cranking power increases with falling temperatures. Sub-zero temperatures reduce capacity of a fully charged battery to 45% of its normal power and at the same time increase cranking load to 3½ times the normal warm weather load.

Hot weather can also place excessive electrical loads on batteries.

Care, Maintenance and Testing of BATTERIES

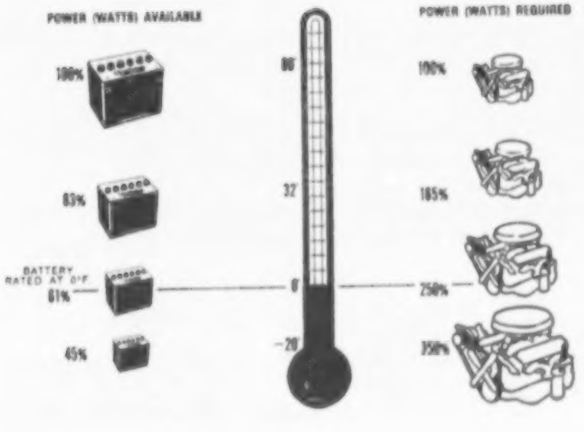


Figure 11—Battery power shrinks while the need for engine cranking power increases with falling temperature.

Difficulty in starting may occur when cranking is attempted shortly after a hot engine has been turned off or stalls. In fact modern high compression engines can be as difficult to start under such conditions as on the coldest winter day. Consequently, good performance can be obtained only if the battery has ample capacity to cope with these conditions.

A battery of greater capacity should be considered if the electrical load has been increased through the addition of accessories or if driving conditions are such that the generator cannot keep the battery in a charged condition.

On applications where heavy electrical loads are encountered, a higher output generator that will supply a charge during low speed operation may be required to increase battery life and improve battery performance.

INSTALLING BATTERIES

To install a battery properly, it is important to observe the following precautions:

1. Connect grounded terminal of battery last to avoid short circuits which may damage the electrical system.
2. Be sure there are no foreign objects in the carrier, so that the new battery will rest properly in the bottom of the carrier.
3. Tighten the hold-down evenly until snug. Do not draw down tight enough to distort or crack the case or cover.
4. Be sure the cables are in good condition and the terminal clamps are clean and tight. Studs of the cable terminals should be securely tightened but not overly tightened (70lb.-in.). Apply petroleum jelly over battery post and cable clamp connections. Make sure the ground cable is clean and tight at engine block or frame.
5. Check polarity to be sure the battery is not reversed with respect to the generating system.

EMERGENCY STARTING

- Never tow the car to start because the surge forward when the engine starts could cause a collision with the two vehicles.
- Engines in vehicles with automatic transmissions cannot be started by pushing the car.
- To start the car when the battery is discharged, use a single auxiliary battery or battery of the **same nominal voltage** as the discharged battery, with suitable jumper cables.
- Make connections as set forth below under "Jump Starting With Auxiliary (Booster) Battery" to lessen the chance of personal injury or property damage.

WARNING: Never expose battery to open flame or electric spark—battery action generates hydrogen gas which is flammable and explosive. Don't allow battery fluid to contact skin, eyes, fabrics, or painted surfaces—fluid is a sulfuric acid solution which could cause serious personal injury or property damage. Wear eye protection when working with battery.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

Both booster and discharged battery should be treated carefully when using jumper cables. Follow exactly the procedure outlined below, being careful not to cause sparks:

1. Set parking brake and place automatic transmission in "PARK" (neutral for manual transmission). Turn off lights, heater and other electrical loads.
2. Except on batteries with flame arresier caps, remove vent caps from both booster and discharged batteries. Lay a cloth over the open vent wells of each battery. Leave flame arrester caps in place; no cloth is needed. These actions help reduce the explosion hazard always present in either battery when connecting "live" booster batteries to dead batteries.

NEGATIVE GROUND ONLY

3. Attach one end of one jumper cable to the positive terminal of the **booster battery** and the other end of same cable to positive terminal of **discharged battery.** DO NOT PERMIT vehicles to touch each other as this could establish a ground connection and counteract the benefits of this procedure.

4. Attach one end of the remaining negative (−) cable to the negative terminal of the **booster battery,** and the other end to a ground at least 12 inches from the battery filler caps of the vehicle being started. (DO NOT CONNECT DIRECTLY TO THE NEGATIVE POST OF THE DEAD BATTERY.)

POSITIVE GROUND ONLY

5. Attach one end of one jumper cable to the negative terminal of the **booster battery** and the other end of the same cable to negative terminal of **discharged battery.** DO NOT PERMIT vehicles to touch each other, as this could establish a ground connection and counteract the benefits of this procedure.

6. Attach one end of the remaining positive cable to the positive terminal of the **booster battery** and the other end to a ground at least 12 inches from the battery filler caps of the vehicle being started. (DO NOT CONNECT DIRECTLY TO THE POSITIVE POST OF THE DEAD BATTERY.)

NEGATIVE GROUND AND POSITIVE GROUND

7. Take care that the clamps from one cable do not inadvertently touch the clamps on the other cable. Do not lean over the battery when making this connection. This ground connection must provide good electrical conductivity and current carrying capacity and avoid moving, hot or electrical hazards such as fans, manifolds and spark plug terminals.

8. Reverse this sequence exactly when removing the jumper cables.

9. Reinstall vent caps and throw cloths away as the cloths may have corrosive acid on them.

WARNING: Any procedure other than the above could result in: 1) personal injury caused by electrolyte squirting out the battery vents, 2) personal injury or property damage due to battery explosion, 3) damage to the charging system of the booster vehicle or of the immobilized vehicle.

Care, Maintenance and Testing of BATTERIES

DELCO BATTERY TEST PROCEDURE

INTRODUCTION—To determine the ability of a battery to function properly requires testing. The accuracy of the testing changes with temperature, specific gravity, age of the battery, etc. An accurate test has more than one step.

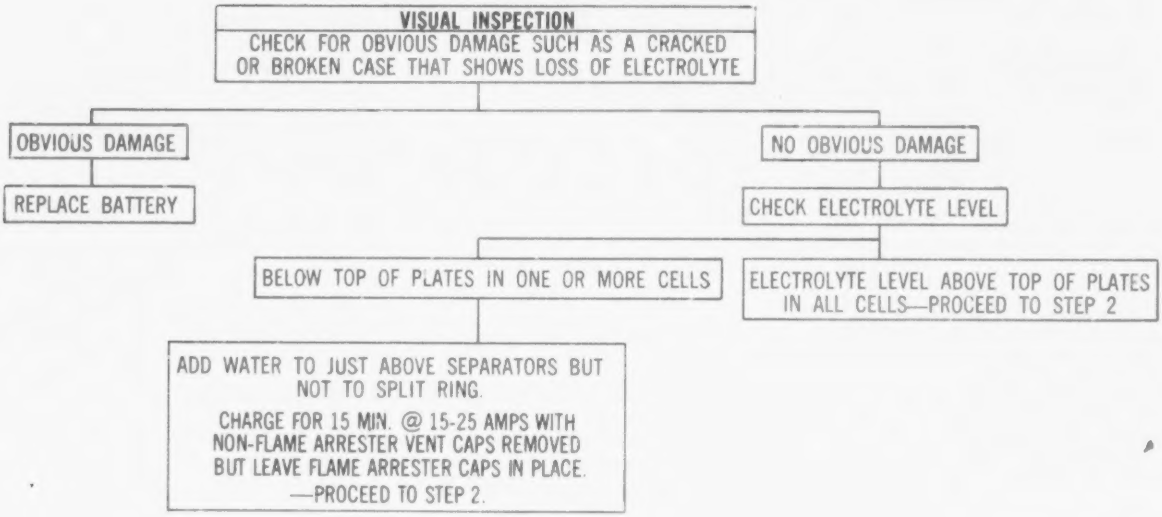
Step 1: Visual inspection

Step 2: Specific gravity check (hydrometer)

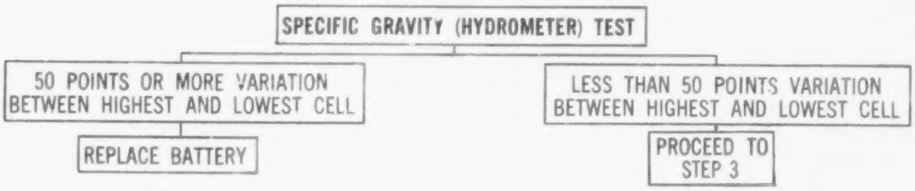
Step 3: Load test

Testing Warning: Wear safety glasses. Do not break live circuits at battery terminals. When testing, be certain to remove gases at battery cover caused by charging.

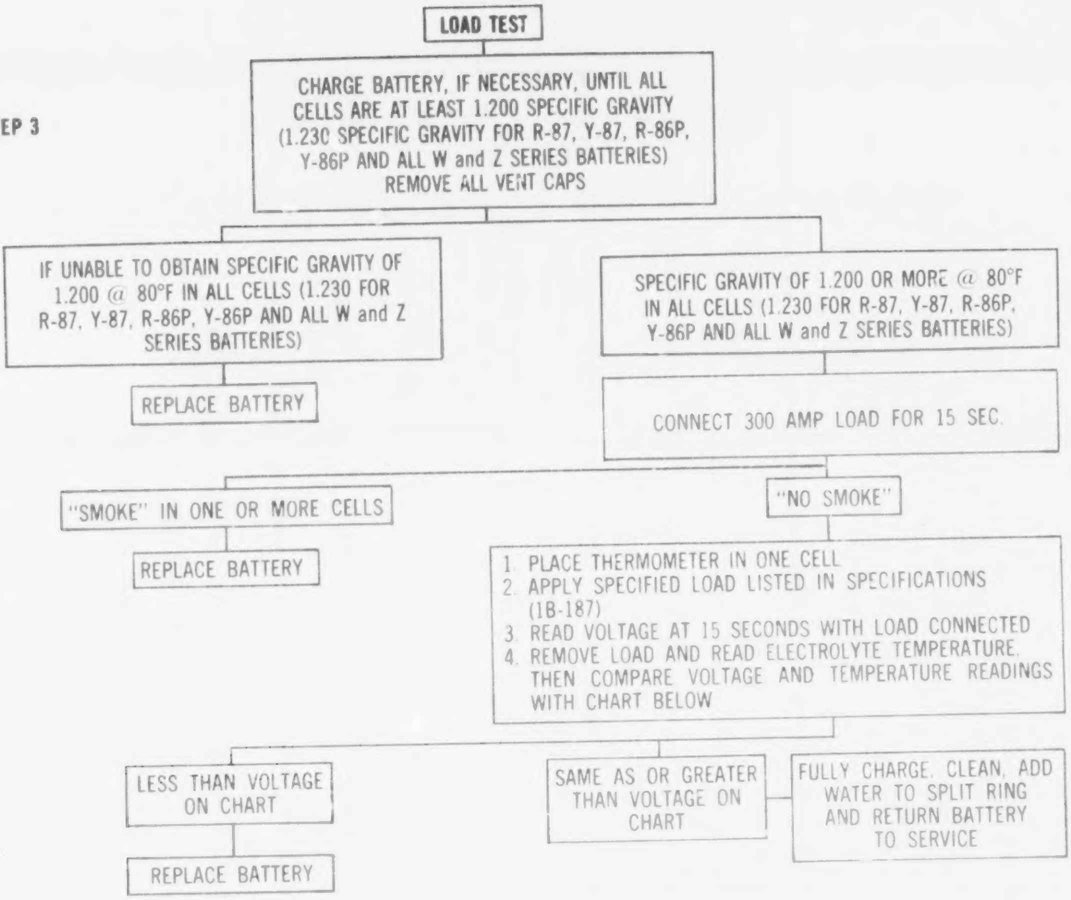
STEP 1


VISUAL INSPECTION
CHECK FOR OBVIOUS DAMAGE SUCH AS A CRACKED OR BROKEN CASE THAT SHOWS LOSS OF ELECTROLYTE
OBVIOUS DAMAGE
REPLACE BATTERY
NO OBVIOUS DAMAGE
CHECK ELECTROLYTE LEVEL
BELOW TOP OF PLATES IN ONE OR MORE CELLS
ELECTROLYTE LEVEL ABOVE TOP OF PLATES IN ALL CELLS—PROCEED TO STEP 2
ADD WATER TO JUST ABOVE SEPARATORS BUT NOT TO SPLIT RING.
CHARGE FOR 15 MIN. @ 15-25 AMPS WITH NON-FLAME ARRESTER VENT CAPS REMOVED BUT LEAVE FLAME ARRESTER CAPS IN PLACE. —PROCEED TO STEP 2.

STEP 2


SPECIFIC GRAVITY (HYDROMETER) TEST
50 POINTS OR MORE VARIATION BETWEEN HIGHEST AND LOWEST CELL
REPLACE BATTERY
LESS THAN 50 POINTS VARIATION BETWEEN HIGHEST AND LOWEST CELL
PROCEED TO STEP 3

STEP 3


LOAD TEST
CHARGE BATTERY, IF NECESSARY, UNTIL ALL CELLS ARE AT LEAST 1.200 SPECIFIC GRAVITY (1.230 SPECIFIC GRAVITY FOR R-87, Y-87, R-86P, Y-86P AND ALL W and Z SERIES BATTERIES) REMOVE ALL VENT CAPS
IF UNABLE TO OBTAIN SPECIFIC GRAVITY OF 1.200 @ 80°F IN ALL CELLS (1.230 FOR R-87, Y-87, R-86P, Y-86P AND ALL W and Z SERIES BATTERIES)
REPLACE BATTERY
SPECIFIC GRAVITY OF 1.200 OR MORE @ 80°F IN ALL CELLS (1.230 FOR R-87, Y-87, R-86P, Y-86P AND ALL W and Z SERIES BATTERIES)
CONNECT 300 AMP LOAD FOR 15 SEC.
"SMOKE" IN ONE OR MORE CELLS
REPLACE BATTERY
"NO SMOKE"
1. PLACE THERMOMETER IN ONE CELL
2. APPLY SPECIFIED LOAD LISTED IN SPECIFICATIONS (1B-187)
3. READ VOLTAGE AT 15 SECONDS WITH LOAD CONNECTED
4. REMOVE LOAD AND READ ELECTROLYTE TEMPERATURE, THEN COMPARE VOLTAGE AND TEMPERATURE READINGS WITH CHART BELOW
LESS THAN VOLTAGE ON CHART
REPLACE BATTERY
SAME AS OR GREATER THAN VOLTAGE ON CHART
FULLY CHARGE, CLEAN, ADD WATER TO SPLIT RING AND RETURN BATTERY TO SERVICE

VOLTAGE AND TEMPERATURE CHART

Voltage must not drop below minimum listed at given temperature when battery is subjected to the proper load for 15 seconds and is 1.200 specific gravity @ 80°F or more (1.230 for R-87, Y-87, R-86P, Y-86P and all W and Z series batteries)

	MINIMUM VOLTAGES								
Voltage	Electrolyte Temperature Down To								
	80°F	70°F	60°F	50°F	40°F	30°F	20°F	10°F	0°F
6-Volt	4.8	4.8	4.7	4.7	4.6	4.5	4.4	4.3	4.2
8-Volt	6.4	6.4	6.3	6.2	6.1	6.0	5.9	5.7	5.6
12-Volt	9.6	9.6	9.5	9.4	9.3	9.1	8.9	8.7	8.5

BATTERY CHARGING GUIDE

(6-Volt and 12-Volt Batteries)

Recommended Rate* and Time for Fully Discharged Condition

Reserve Capacity Rating	Twenty Hour Rating	5 Amperes	10 Amperes	20 Amperes	30 Amperes	40 Amperes
75 Minutes or less	**50 Ampere-Hours or less**	10 Hours	5 Hours	2½ Hours	2 Hours	
Above 75 To 115 Minutes	**Above 50 To 75 Ampere-Hours**	15 Hours	7½ Hours	3¼ Hours	2½ Hours	2 Hours
Above 115 To 160 Minutes	**Above 75 To 100 Ampere-Hours**	20 Hours	10 Hours	5 Hours	3 Hours	2½ Hours
Above 160 To 245 Minutes	**Above 100 To 150 Ampere-Hours**	30 Hours	15 Hours	7½ Hours	5 Hours	3½ Hours
Above 245 Minutes	**Above 150 Ampere-Hours**		20 Hours	10 Hours	6½ Hours	5 Hours

*Initial rate for constant voltage taper rate charger

To avoid damage charging rate must be reduced or temporarily halted if:

1. Electrolyte temperature exceeds 125°F.
2. Violent gassing or spewing of electrolyte occurs.

Battery is fully charged when over a two hour period at a low charging rate in amperes all cells are gassing freely and no change in specific gravity occurs. **For the most satisfactory charging, the lower charging rates in amperes are recommended.**

Full charge specific gravity is 1.260-1.280 corrected for temperature with electrolyte level at split ring.

Volume 5
Supplemental Maintenance and Repair Parts Instructions

750 CFM Rotary Screw Air Compressor

Stock Number 4310-01-053-3891
Contract DSA700-77-C-8407

SUPPLEMENTAL MAINTENANCE AND REPAIR PARTS INSTRUCTIONS
FOR
CCE 100 PSI 750 CFM AIR COMPRESSOR

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Section I. GENERAL

1-1. Purpose. To provide user and support personnel with supplemental maintenance and repair parts instructions that have special application to Commercial Construction Equipment (CCE) items.

1-2. Scope. This publication applies to Department of the Army Units, Organizations and Activities that use and/or support the 100 PSI 750 CFM Air Compressor (CCE).

1-3. CCE Item. The term "CCE Item" used in this publication applies to a standard commercial item of commercial equipment that has been approved for specific TOE requirements and is procured and supported under the CCE System Plan. This plan permits maximum utilization of the civilian construction industry's competitive research and development, manufacturer's equipment publications, and commercial sources for repair parts.

1-4. Description. The 100 PSI 750 CFM Air Compressor (CCE) is manufactured by the Sullair Corporation of Michigan City, Indiana. The compressor unit is a rotary screw, single stage, oil flood lubrication type. It consists of two helical screw rotors supported by anti-friction bearings, a stator, inlet and outlet housings, a gear housing with two helical gears, an oil seal, and input shaft with supporting antifriction bearings. The engine used to drive the compressor unit is a Detroit Diesel Model 6V-71N.

1-5. Operational Concept. The principal function of this air compressor is for the operation of rock drilling equipment, and pneumatic tool outfits in engineer construction units. The new CCE air compressor will replace the current military 600 CFM compressors (as listed under LIN E73352 of SB 700-20), on a normal attrition basis or sooner if required by operational considerations. The current 600 CFM compressors will be retained as an authorized in-lieu-of item until current stocks are exhausted. The 600 CFM and 750 CFM air compressors can be used on secondary and off road conditions and are capable of safe and effective use in climatic categories 1, 2, 5, and 6 of chapter 2, AR 70-38.

1-6. Procurement Status. The procurement contract number is DSA 700-77-C-8407 and was awarded on 1 Jul 77.

1-7. Equipment Publications.

a. Initially two sets of the manufacturer's commercial publications will be overpacked and shipped with each compressor.

b. The overpacked publications are located in the canvas bag affixed to the inside door.

1-8. Personnel and Training.

a. MOS Requirements:

(1) Operator: 62J20, General Construction Machine Operator.
(2) Organizational Maintenance: 62B20, Construction Equipment Repairman.

(3) Direct and General Support Maintenance: 62B30, Construction Equipment Repairman; 63G20, Fuel and Electrical Systems Repairman, 44B20 Metal Body Repairman.

b. New Equipment Training: New Equipment Training Teams (NETTs) are available to major field commands. Requests for NETTs should be forwarded to Commander, US Army Tank-Automotive Materiel Readiness Command (TARCOM), ATTN: DRSTA-MLT, Warren, MI 48090. Training teams should be requested only when trained personnel are not available in the command to operate and/or maintain the compressor.

1-9. Logistics Assistance.

a. Tank-Automotive Command Field Maintenance Technicians stationed at CONUS and OCONUS installations will be fully qualified and available to furnish on-site training and/or assistance concurrent with receipt of the compressor.

b. Assistance can be obtained by contacting the Logistics Assistance Office listed in appendix B of AR 700-4.

1-10. Warranty. The CCE compressor contractor warrants the products furnished under this contract according to the terms and conditions described in the equipment publications and appendix B of this publication. All warranties furnished to the compressor contractor by subcontractors of assemblies or components utilized in the manufacture of the end item will be extended to the Government.

Section II. MAINTENANCE

2-1. Maintenance Concept. The CCE air compressor will not require any new or special maintenance considerations. All maintenance functions can be accomplished within the current maintenance concepts established for construction equipment.

a. Operator/Crew Maintenance: Operator and crew maintenance is limited to daily preventive maintenance checks and services.

b. Organizational Maintenance: Organizational maintenance consists of scheduled preventive maintenance services, minor repairs, and adjustments.

c. Direct Support Maintenance: Direct support maintenance consists of repairs on-site or in a direct support unit's shops. Repairs are accomplished with a minimum of tools and test equipment; the assemblies and end items, thus repaired, are returned to their users.

d. General Support Maintenance: General support maintenance overhauls selected assemblies and repairs items designated by the area support command for return to stock.

e. Depot Maintenance: Depot maintenance overhauls end items and selected major assemblies when they are required to satisfy overall Army requirements. Overhaul of the compressor may also be performed by contract with the manufacturer.

2-2. Maintenance Allocation Chart. Maintenance will be performed as necessary by the category indicated in the Maintenance Allocation Chart (MAC) to retain or restore serviceability. All authorized maintenance within the capability of a using organization will be accomplished before referring the compressor to support maintenance. Higher categories will perform the maintenance functions of lower categories when required or directed by the appropriate Commanders. Using and support units may exceed their authorized scope and functions in the MAC when approval is granted by the next higher support maintenance Commander.

2-3. Modifications. Modifications will be accomplished by the compressor manufacturer after TARCOM approves the field campaign or modification plan.

2-4. Equipment Improvement Recommendations (EIR). Equipment Improvement Recommendations will be submitted in accordance with TM 38-750.

2-5. Equipment Serviceability Criteria (ESC). Equipment Serviceability Criteria are not applicable to the compressor (AR 750-1).

2-6. Maintenance Expenditure Limits. The average life expectancy for the compressor is 12 years.

PERCENT OF REPAIR	YEAR
59%	1981
55%	1983
50%	1985
45%	1987
35%	1989
25%	1991
10%	1993

2-7. Shipment and Storage.

a. Shipment and Storage. Refer to TB 740-97-2 for procedures covering preservation of equipment for shipment and storage.

b. Administrative Storage. Refer to TM 740-90-1 for instructions covering administrative storage of equipment.

2-8. Destruction to Prevent Enemy Use. Refer to TM 750-244-3 for procedures covering destruction of equipment to prevent enemy use.

2-9. Fire Protection.

a. A hand operated fire extinguisher may be installed at the discretion of the using unit.

b. Approved hand-portable fire extinguishers are listed in TB 5-4200-200-10.

2-10. Special Tools and Equipment. No special tools or equipment are required for operation and maintenance of the compressor.

2-11. Maintenance Forms and Records. Operational, Maintenance, and Historical records will be maintained as required by the current TM 38-750.

a. Operational Records: Operational records (DA Forms 2400 and 2401) are optional and may be utilized at the discretion of the using organization.

b. Maintenance Records:

(1) DA Form 2402, Exchange Tag.
(2) DA Form 2404, Equipment Inspection and Maintenance Worksheet.
(3) DA Form 2405, Maintenance Request Register.
(4) DA Form 2407, Maintenance Request.
(5) DD Form 314, Preventive Maintenance Schedule and Record.

c. Historical Records:

(1) DA Form 2408, Equipment Logbook Assembly.
(2) DA Form 2408-1, Equipment Daily and Monthly Log.
(3) DA Form 2408-5, Equipment Modification Record.
(4) DA Form 2408-9, Equipment Control Record.
(5) DA Form 2408-14, Uncorrected Fault Record.
(6) DA Form 2410-10, Equipment Component Register.

2-12. Towing and Trailering.

a. Towing. When towing the compressor, do not exceed 15 miles per hour.

b. Trailering. Removal of mufflers, to reduce height, is recommended when moving the air compressor by trailer.

Section III. REPAIR PARTS SUPPLY

3-1. General.

a. The basic policies and procedures in AR 710-2 and AR 725-50 are generally applicable to repair parts management for CCE items.

b. Manufacturer's parts manuals are furnished with CCE items instead of Department of the Army Repair Parts and Special Tool List (RPSTL).

c. National Stock Number (NSNs) are initially assigned only to PLL/ASL parts and major assemblies, i.e., engines, transmissions, etc. Additional NSNs are assigned by the supply support activities as demands warrant.

d. Automated Processing (AUTODIN) of Federal Supply Code for Manufacturer (FSCM) part number requisitions, without edit for matching NSNs and exception data, is authorized.

e. Proper use of Direct Support Systems (DSS) project codes and weapon systems designator codes on parts requisitions is essential.

f. Repair parts are available from commercial sources and may be purchased locally in accordance with AR 710-2 and AR 734-110.

g. Initial Prescribed Load List (PLL) and Authorized Stockage List (ASL) will be distributed by US Army Tank-Automotive Materiel Readiness Command (TARCOM), ATTN: DRSTA-FH.

3-2. Prescribed Load List (PLL). The PLL distributed by TARCOM is an estimated 15 days supply recommended for initial stockage at organizational maintenance. Management of PLL items will be governed by the provisions of AR 710-2 and local command procedures. Selection of PLL parts for shipment to CONUS/OCONUS units is based upon the receiving Command's recommendation after their review of the TARCOM prepared list. Organizations and activities in CONUS/OCONUS will establish PLL stocks through normal requisitioning process.

3-3. Authorized Stockage List (ASL). The ASL distributed by TARCOM is an estimated 45 days supply of repair parts for support units and activities. The ASL parts will be shipped according to the recommendations of the receiving commands, after they have reviewed the initial list distributed by TARCOM. Support units and activities in CONUS/OCONUS will establish ASL stocks through normal requisitioning process.

3-4. Requisitioning Repair Parts.

a. Using Units/Organizations: Requisitions (DA Form 2765 Series) will be prepared according to AR 710-2 and local command directives. All requisitions will have the Weapons System Designator code "35" (see appendix N, AR 710-2) entered in the 2nd and 3rd positions of block 18. Units in CONUS will use DSS code "BGW" in block 19. Units OCONUS will enter in block 19 project code "JZC", (see appendix M).

b. Support Units and Activities:

(1) General: All MILSTRIP requisitions (DD Form 1348 Series) prepared for repair parts support of CCE items will include distribution and project codes, (see appendixes N, O, and P).

(2) Distribution Code: Supply customers in CONUS will use code "F" in card column 54. Customers OCONUS will use the appropriate code from appendix P, paragraph P-3a(1) AR 725.50. Weapons System Designator code "35" (appendix N, AR 710-2), will be entered in card columns 55 and 56 of all requisitions for parts to support the compressor.

(3) Project Codes: The applicable DSS project code will be entered in card columns 57-59 of requisitions for NSN parts, whether CONUS or OCONUS customers. The DSS code will also be used by CONUS customers when requisitioning part numbered parts. Supply customers OCONUS will use project code "JZC" for part numbered parts.

3-5. Submitting Requisitions.

a. Using units and organizations will submit DA Form 2765 Series requisitions to designated support units or activities in accordance with local procedures.

b. Support units and activities will forward MILSTRIP requisitions for NSN parts through the Defense Automated Addressing System (DAAS) to the Managing Supply Support Activity. Requisitions for part numbered parts will be forwarded through DAAS to the Defense Construction Supply Center (DCSC).

NOTE

When the manufacturer's part number and Federal Supply Code for Manufacturer (FSCM) exceed the space in card columns 8 through 22 of A02/A0B requisitions, prepare an A05/A0E requisition (DD Form 1348-6) and mail it to Commander, Defense Construction Supply Center, ATTN: DCSC-OSR, Columbus, Ohio 43215.

best copy available

APPENDIX A

REFERENCES

A-1. Publication Indexes.

Indexes should be consulted frequently for latest changes of revisions of references and for new publications relating to material covered in this publication.

Index of Administrative Publications	DA PAM 310-1
Index of Blank Forms	DA PAM 310-2
Index of Doctrinal Training and Organization Publications	DA PAM 310-3
Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders	DA PAM 310-4
Index of Graphic Training Aid and Devices	DA PAM 310-5

A-2. Forms.

Refer to TM 38-750, The Army Maintenance Management System (TAMMS), for instructions on the use of maintenance forms pertaining to the materiel.

A-3. Other Publications.

The following publications contain information pertinent to the major item and associated equipment.

a. Camouflage.

Camouflage	FM 5-20

b. Decontamination.

Chemical, Biological, and Radiological (CBR) Decontamination	TM 3-220
Nuclear, Biological and Chemical Defense	FM 21-40

c. General.

Basic Cold Weather Manual	FM 31-70
Northern Operations	FM 31-71
Operation and Maintenance of Ordnance Materiel in Cold Weather (0° to -65°F)	FM 9-207
Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use	TM 750-244-6

d. Maintenance and Repair

Organizational Care, Maintenance, and Repair of Pneumatic Tires	TM 9-2610-200-20
Inspection, Care and Maintenance of Antifriction Bearings	TM 9-214
Welding Theory and Application	TM 9-237

e. Administrative Storage.

Administrative Storage of Equipment	TM 740-90-1

APPENDIX B

WARRANTY GUIDELINES

B-1. A warranty period of two years after delivery to the Government applies to the air compressor unit (PN10947-110), contract number DSA700-77-C-8407, manufactured by Sullair Company. All remaining items are under warranty for a period of one year after delivery to the Government, i.e., engine and components.

B-2. CONUS units may contact the local dealer shown on the distributor list furnished with each compressor. OCONUS units must report all warranty claims as indicated in paragraph B-3a.

B-3. General Information:

a. DA Form 2407 (prepared in accordance with warranty claim actions in TM 38-750) will be used to submit warranty claims actions for end items when components, parts, or assemblies are defective and are covered by a manufacturer's warranty. End items under warranty are identified by a decal plate and/or warranty statement included in the operator's and maintenance manual for the end item. All warranty actions settled or unsettled, will be reported to the National Maintenance Point (NMP) on DA Form 2407. For warranties settled locally the DA Form 2407 will contain a statement "For Information Only" in block 35.

b. Maintenance activities in support of organizational maintenance are the responsible points of contact between the originator of warranty claims and the National Maintenance Point, US Army Tank-Automotive Materiel Readiness Command, DRSTA-MVB, AUTOVON 369-2434, 369-2652, 369-2486, Warren, Michigan 48090, which serves as the DA representative with the contractor in warranty matters.

NOTE

In certain instances, the originating organization and the support activity are one and the same.

c. Before you take your equipment to a dealer for repair, whether or not it was necessary for you to go through the NMP (TARCOM), check with your local procurement office to see if a funds commitment document is needed. Sometimes, even though the majority of the repairs are covered by the warranty, there may be a small charge for normal maintenance costs, i.e., oil filters, oil, etc. Further, the cause of damage could be determined by the dealer to be directly related to "operator abuse." In that case, the Government may be obligated to pay for teardown services even if the repairs are no longer desired, or for the complete cost if repairs are to be completed by the dealer.

d. When the compressor is given to the dealer for repairs, find out how long the work will take, the extent of the problem if possible, and the charges if any, which may be involved. Leave the name and telephone number of the person to be contacted for pickup of the equipment and specifically state that he should be called as soon as the repairs are finished. In addition, state that he should be telephoned if unexpected problems, costs and/or delays are encountered. Get the name and telephone number of the Service Manager, for any required follow-up purposes.

e. When you arrive to pick up your equipment after completion of services, make certain that you know exactly what repairs were performed and/or parts replaced. This is required for overall problem trend evaluation by the NMP and must be identified upon completion of warranty services.

f. Telephone the NMP at TARCOM, AUTOVON 369-2434, 369-2652 and/or 369-2486 if:

(1) Your equipment requires repairs and you cannot obtain these services using the procedures listed above.

(2) The length of time required for repairs may seriously hamper your mission, or if the dealer's overall response to your requirements is not satisfactory.

(3) You have any questions regarding warranty procedures - either in general or about a specific job. Do not wait until your problems become critical.

g. Do not attempt to conduct negotiations regarding a breach of warranty. This is a function of the Contracting Officer, through the NMP at TARCOM.

h. When you receive your new compressor, please fill out and mail the warranty card enclosed with your manuals to Sullair Company. This card will assist the contractor in implementing the warranty, and contacting you directly if the need should arise.

APPENDIX C

MAINTENANCE ALLOCATION CHART

FOR

100 PSI 750 CFM AIR COMPRESSOR (CCE)

Section I. INTRODUCTION

C-1. General: This Maintenance Allocation Chart designates responsibility for performance of maintenance functions to specific maintenance categories.

C-22. Maintenance Functions:

a. Inspect: To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test: To verify serviceability and detect incipient failures by measuring the mechanical or electical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service: Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust: To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Align: To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate: To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install: The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace: The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair: The application of maintenance services or other maintenance actions to restore serviceablity to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul: That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild: Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc) considered in classifying Army equipment/components.

C-3. Column entries: Columns used in the maintenance allocation chart are explained below:

a. Column 1, Group Number: Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly: Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions: Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Category: Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of manhours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the Maintenance Allocation Chart.

e. Column 5, Tools and Equipment: Column 5 specifies by code those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks: Column 6 contains an alphabetic code which leads to the remarks in section IV, remarks, which is pertinent to the item opposite the particular code.

Section II. MAINTENANCE ALLOCATION CHART

100 PSI 750 CFM AIR COMPRESSOR (CCE)

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
01	ENGINE								
0100	Engine assy, Diesel	Service		0.5				1,2,3	
		Test		2.0					
		Replace		16.0					
		Repair		48.0					
		Overhaul				60.0			
0101	Cylinder Head	Replace		4.0				1,2,3	
		Repair		6.0					
	Cylinder Sleeve assy	Replace				3.0			
0102	Crankshaft	Replace				16.0		1,2,3	
		Repair					12.0		
	Bearing Sleeve	Replace				2.0			
	Vibration Damper	Replace			1.0				
	Crankshaft Pulley	Replace			1.0				
	Seals	Replace				1.0			
0103	Flywheel assy	Replace			1.5			1,2,3	
		Repair				2.0			
0104	Pistons, Rings, Pins and Retainers	Replace				2.0		1,2,3	
	Connecting Rods	Replace				2.0			
	Rings and Bearings	Replace				1.5			
0105	Valves and Camshafts								
	Rocker Arms	Replace			1.0			1	
	Valve Springs	Test			1.0			1	
		Replace			2.5				

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

Section II. MAINTENANCE ALLOCATION CHART--continued

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
0106	Engine Lubrication System								
	Oil Pan	Replace			1.0			1	
		Repair			1.5				
	Oil Pump	Replace			2.0				
		Repair				3.0			
	Oil Pressure Regulator	Adjust			0.5				
		Replace			0.5				
	Oil Filter assy	Service		0.2					
		Replace			0.5				
		Repair			0.5				
	Oil Filter Element	Replace		0.3					
0108	Manifolds	Replace			1.5			1,2,3	
		Repair			2.0				
03	FUEL SYSTEM							1	
0301	Fuel Injector	Test			0.5				
		Replace			1.0				
		Repair				1.0			
0302	Fuel Pump	Replace			2.0			1	
		Repair			3.0				
0304	Air Cleaner	Service	0.2					1	
		Replace		1.2					
		Repair		1.0					
	Air Cleaner Element	Replace		0.5					

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

Section II. MAINTENANCE ALLOCATION CHART--continued

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
0306	Fuel Tank	Service	0.5					1	
		Replace		1.5					
		Repair		2.0					
	Lines and fittings	Replace		2.0					
		Repair		1.0					
0309	Fuel Filters	Service	0.3					1	
		Replace		0.9					
0309	Fuel Filter Element	Replace		0.3				1	
0311	Engine Starting Aids								
	Ether Kit	Install	0.2						
	Ether Cylinder	Replace	0.1						
04	EXHAUST SYSTEM								
0401	Muffler and Pipes	Replace		1.0				1	
		Repair		1.0					
05	COOLING SYSTEM								
0501	Radiator	Service	0.5					1	
		Replace			1.0				
		Repair			2.0				
0502	Guards and Shrouds	Replace		1.0				1	
		Repair		0.5					
0503	Water Manifolds, Headers, Thermostat and Housing							1	
	Gasket	Replace		1.0					
	Hoses and Clamps	Replace		0.5					

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

Section II. MAINTENANCE ALLOCATION CHART--continued

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
0504	Water Pump	Replace		0.5				1	
		Repair			1.0				
0505	Fan assy	Replace		0.5				1	
		Repair		0.5					
	Belt, Drive	Adjust		0.2					
		Replace		0.5					
06	ELECTRICAL SYSTEM								
0601	Alternator	Test		0.5				1,4	
		Replace		0.5					
		Repair			1.0				
	Belt, Drive	Adjust		0.2					
		Replace		0.5					
0602	Voltage Regulator	Test		0.5				1,4	
		Adjust			0.5				
		Replace			0.5				
0603	Starting Motor	Test			0.5			1,4	
		Replace		0.8					
		Repair			1.0				
0606	Engine Safety Switches	Replace		0.2				1	
0607	Instrument Panel								
	Gages	Replace		0.5				1	
	Wiring	Replace		0.5					
0608	Miscellaneous Items							1	
	Fuses	Replace	0.1						
	Compressor Discharge Temperature Safety Switch	Replace		0.5					

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

Section II. MAINTENANCE ALLOCATION CHART--continued

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
0612	Batteries, Storage	Inspect	0.1						
		Service	0.2						
		Replace		0.2					
0613	Wiring Harness	Replace			0.5			1	
		Repair		0.2				4	
10	FRONT AXLE								
1000	Front Axle assy							1	
	Drawbar	Replace		0.3					
		Repair			1.0				
	Steering assy	Service		0.3					
		Replace			1.0				
		Repair			2.0				
	Axle	Replace			1.0				
		Repair			2.0				
11	REAR AXLE							1	
1100	Rear Axle assy	Replace			1.0				
		Repair			2.0				
12	BRAKES								
1201	Hand Brake	Replace		1.0				1	
		Repair		0.5					
13	WHEEL								
1311	Wheel assy							1	
	Bearings	Service		0.2					
		Replace		0.5					
	Seals	Replace		0.5					

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

Section II. MAINTENANCE ALLOCATION CHART--continued

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
1311	Tires and Tubes	Inspect	0.1					1	
		Replace		0.3					
		Repair		0.5					
15	FRAME							1	
1501	Frame	Replace				2.0			
		Repair				3.0			
16	SPRINGS							1	
1601	Springs	Inspect	0.2						
		Replace		0.4					
18	BODY							1	
1801	Body, Cab, Hood, and Hull								
	Frame Canopy	Replace			1.0				
		Repair			0.5				
	Door assy	Replace		0.2					
		Repair			0.1				
	Lower Grille assy	Replace		0.2					
		Repair			0.1				
1802	Fenders	Replace		0.5				1	
		Repair			0.2				
1805	Floors, Subfloors, and Related Components							1	
	Side sill	Replace		0.3					
		Repair			0.2				
	Top sill	Replace		0.2					
		Repair			0.2				

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

Section II. MAINTENANCE ALLOCATION CHART--continued

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
50	COMPRESSOR							1,2,3	
5000	Air Compressor assy	Test		1.0					
		Replace			2.0				
5004	Seals	Replace			1.0			1	
5006	Lubrication System							1	
	Cooler, Oil	Service		0.2					
		Replace			1.0				
		Repair			2.0				
	Filter, Main Oil	Service		0.2					
		Replace		0.1					
	Filter, Bearing Oil	Service		0.2					
		Replace		0.1					
	Oil Sump (Receiver)	Service		0.2					
		Replace			1.5				
	Lines and Fittings	Replace		2.0					
5007	Compressor Drive								
	Housing assy	Replace			1.0			1	
	Drive Ring, Hub, Gear, Retainer Plate	Replace			1.0				
5008	Air Intake							1	
	Filter, Air	Service		0.5					
		Replace		0.2					
	Valve, Inlet	Replace		0.5					
	Ducts, Clamps	Replace		0.5					
5009	Unloader System Components							1	
	Valve, Blowdown	Repair			0.5				
		Replace			0.5				
	Hose, Blowdown	Replace			0.2			1	

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

Section II. MAINTENANCE ALLOCATION CHART--continued

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level*					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
5010	Compressor Cooling and Heating							1	
	Housing, Thermostatic	Replace		0.2					
	Element, Thermostatic	Replace		0.1					
5012	Throttling Devices							1	
	Pressure Regulator	Adjust		0.2					
		Repair			0.5				
		Replace		0.3					
	Control	Replace		0.3					
		Repair			0.5				
	Tubing and Connectors Linkage	Replace		0.3					
		Adjust		0.2					
		Repair		0.2					
5014	Air Receiver (Oil Sump)							1	
	Separator assy								
	Element Kit, Separator	Replace		0.5					
	Valve, Pop Safety	Replace		0.3					
	Valve, Discharge Check	Replace		0.5					
		Repair			1.0				
5015	Air Discharge System							1	
	Valve, Minimum Press.	Replace		0.5					
		Repair			1.0				
	Valve, Check	Replace		0.3					

*The subcolumns are as follows:

C-operator/crew
O-organizational
F-direct support
H-general support
D-depot

MAINTENANCE ALLOCATION CHART FOR

100 PSI 750 CFM AIR COMPRESSOR (CCE)

SECTION III - TOOL AND TEST EQUIPMENT REQUIREMENTS

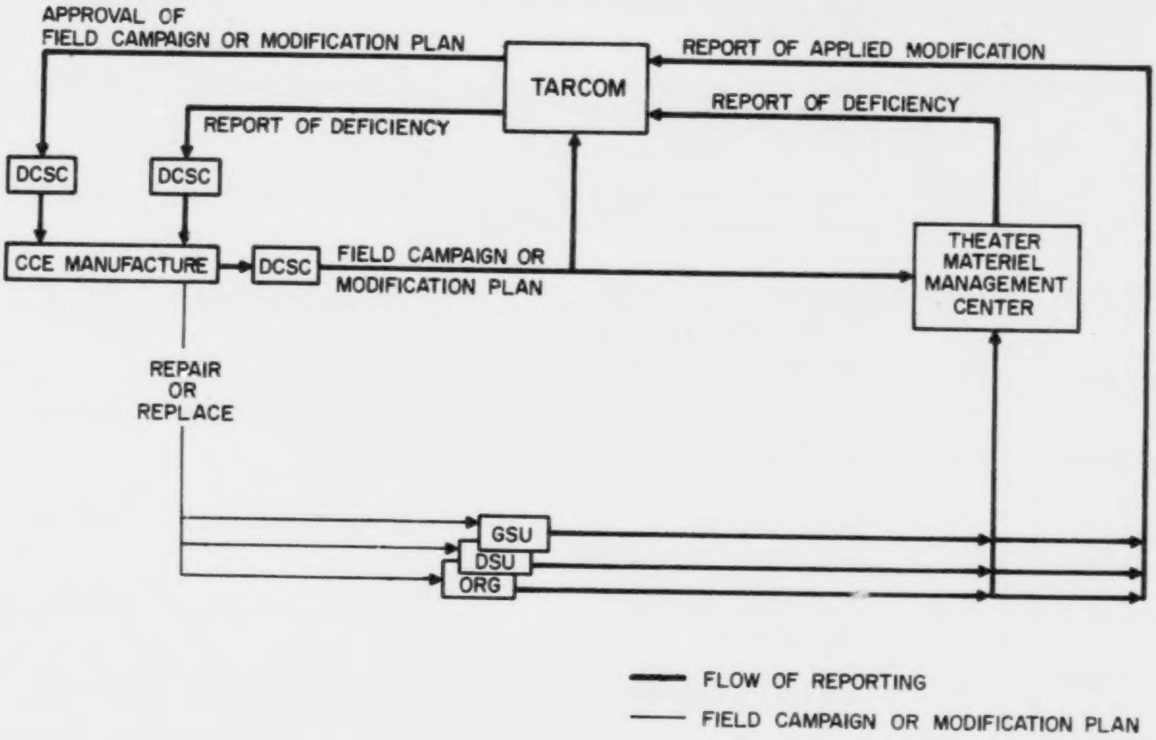
TOOL OR TEST EQUIPMENT REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
		NOTE Unless otherwise noted, all maintenance functions can be accomplished with the tools contained in the following common tool sets.		
1.	O,F,H	Shop Equip, Contact Maint, TRK MTD (SC 4940-97-CL-E-05)	4940-00-294-9518	T10138
	O,F,H	Shop Equip, Org Repair, Light TRK MTD (SC 4940-97-CL-E04)	4940-00-294-9516	T13152
	O,F,H	Tool Kit, Automotive Maint, Org Maint Common #1 (SC 4910-95-CL-A74)	4910-00-754-0654	W32593
	O,F,H	Tool Kit, Automotive Maint, Org Maint Common #2 (SC 4910-95-CL-A72)	4910-00-754-0650	W32730
	O,F,H	Tool Kit, Light Weight (SC 5180-90-CL-N26)	5180-00-177-7033	W33004
	O,F,H	Shop Equip, Auto Maint and Repair, Org Maint Supp #1 (SC 4910-95-CL-A73)	4910-00-754-0653	W32867
	O,F,H	Shop Equip, Welding, Field Maint (SC 3470-95-CL-A08)	3470-00-357-7268	T16714
	O,F,H	Tool Set, Veh Full Tracked, Supp #2 (SC 4940-95-CL-A08)	4940-00-754-0743	W65747
2.	F,H	Shop Equip, Gen Purp Repair, Semitrlr MTD (SC 4940-97-CL-E03)	4940-00-287-4894	T10549

SECTION III - TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
	F,H	Tool Kit, Automotive, Fuel and Elec Sys Repair (SC 4910-95-CL-A50)	5180-00-754-0655	W32456
	F,H	Tool Kit, Master Mechanic and Equip Maint and Repair (SC 5180-90-CL-N05)	5180-00-699-5273	W45060
	F,H	Shop Set, Fuel and Elec Sys, Field Maint Basic (SC 4910-95-CL-A01)	4910-00-754-0714	T30414
	F,H	Shop Set, Fuel and Elec Sys, Field Maint Basic Supp #2 (SC 4910-95-CL-A65)	4910-00-390-7775	T30688
	F,H	Shop Equip Machine Shop, Field Maint Basic (SC 3470-95-CL-A02)	3470-00-754-0708	T15644
	F,H	Measuring and Lay Out Tool Set, Mach (SC 5280-95-CL-A02)	5280-00-511-1950	W44512
	F,H	Test Set, DSL Ign (SC 4910-IL)	4910-00-317-8265	V73742
	F,H	Tool Kit, Body and Fender Repair	5180-00-754-0643	W33689
	F,H	Wrench Set, Socket, 3/4" Drive, Hex Type		Y75239
3.	F,H	Wrench, Torque, 3/4" Drive 500 lb cap	5120-00-542-5577	Y84966
4.	O,F,H	Multimeter	6625-00-999-7465	M80242

APPENDIX D

CCE MANUFACTURER FIELD CAMPAIGNS AND MODIFICATION PROCEDURES


APPROVAL OF FIELD CAMPAIGN OR MODIFICATION PLAN
TARCOM
REPORT OF APPLIED MODIFICATION
REPORT OF DEFICIENCY
REPORT OF DEFICIENCY
DCSC
DCSC
CCE MANUFACTURE
DCSC
FIELD CAMPAIGN OR MODIFICATION PLAN
THEATER MATERIEL MANAGEMENT CENTER
REPAIR OR REPLACE
GSU
DSU
ORG
FLOW OF REPORTING
FIELD CAMPAIGN OR MODIFICATION PLAN

TA072413

APPENDIX E

COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

E-1. Scope.

This appendix lists integral components of and basic issue items for the air compressor to help you inventory items required for safe and efficient operation.

E-2. General.

This Components of End Items List is divided into the following sections:

a. Section II. Integral Components of the End Item. There are no integral components that comprise the compressor.

b. Section III. Basic Issue Items. These are the minimum essential items required to place the compressor in operation, to operate it, and to perform emergency repairs. Although shipped separately packed they must accompany the compressor during operation and whenever it is transferred between accountable officers. The illusstrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII, based on TOE/MTOE authorization of the end item.

E-3. Explanation of Columns.

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the illustration on which the item is shown.

(2) Item Number. The number used to identify item called out in the illustration.

b. National Stock Number. Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. Part Number. Indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items.

d. Description. Indicates the Federal item name and, if required, a minimum description to identify the item.

e. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

f. Usable on Code. "USABLE ON" codes are not used in this manual.

g. Quantity Required (Qty Reqd). This column lists the quantity of each item required for a complete major item.

h. Quantity. This column is left blank for use during an inventory. Under the Rcv'd column, list the quantity you actually receive on your major item. The Date columns are for your use when you inventory the major item at a later date; such as for shipment to another site.

Section II. INTEGRAL COMPONENTS OF END ITEM

There are no integral components of the air compressor.

Section III. BASIC ISSUE ITEMS

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8)			
								Quantity			
(a) Fig No.	(b) Item No.	National Stock Number	Part No.	Description	Location	Usable on Code	Qty Req'd	Rcv'd	Date	Date	Date
				NOTE: The following items are overpacked with the compressor.							
		7520-00-559-9618		Case, Cotton Duck: MIL-B-11743 (81349)			1				
		7510-00-889-3494		Log Book Binder: MIL-B-43064			1				
				NOTE: The following item is authorized but not issued with the compressor.							
		4210-00-889-2221		Extinguisher, Fire, Dry Chemical			1				

APPENDIX F

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

F-1. Scope.

This appendix lists expendable supplies and materials you will need to operate and maintain the compressor. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

F-2. Explanation of Columns.

a. Column 1 - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App D").

b. Column 2 - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column 3 - National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column 4 - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

e. Column 5 - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National stock Number	(4) Description	(5) U/M
1	C	6850-00-181-7933	Antifreeze	gal
2	C	9140-00-286-5296	Fuel, Diesel, VV-F-800, DF-2	gal
3	C	9150-00-190-0905	Grease, GAA, MIL-G-10924	gal
4	C	9150-00-402-2372	Oil, Lubricating, Arctic, 5 gal, MIL-L-46167	gal
5	C	9150-00-491-7197	Oil, Lubricating, Arctic, 55 gal, MIL-L-46167	gal
6	C	9150-00-186-6668	Oil, Lubricating, 10 weight, 5 gal can, MIL-L-2104C	gal
7	C	9150-00-188-9858	Oil, Lubricating, 30 weight, 5 gal can, MIL-L-2104C	gal
8	C	9150-00-189-6729	Oil, Lubricating, 30 weight, 55 gal drum, MIL-1-2104C	gal
9	C	9150-00-188-9862	Oil, Lubricating, 40 weight, 55 gal drum, MIL-L-2104C	gal

APPENDIX G

PRESCRIBED LOAD LIST (PLL) and

AUTHORIZED STOCKAGE LIST (ASL)

END ITEM: COMPRESSOR, AIR, ROTARY SCREW, 750 CFM, WHEEL MTD (CCE)
MAKE: SULLAIR
MODEL: 750DPQ

MFR PART NO: N/A
NSN: 4310-00-053-3891
SERIAL NUMBER RANGE 35109 TO 35274
DATE: OCT 78

SMR CODE	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	PART DESCRIPTION	U/M	QTY OF PARTS REQ'D FOR NO. OF END ITEM			
						PLL	ASL		
						1-5	1-5	6-20	21-50
PAOZZ	5330-01-061-7466	40696	31654	Gasket, Inlet	ea		1	2	3
PAFZZ	4820-01-061-7152	1109	31654	Kit, Stop Valve	ea		1	2	4
PAOZZ		10997	53705	Valve, Thermal	ea		1	2	3
PAOZZ	4330-01-061-7761	LFA208D15	02249	Filter, Main Oil	ea		2	4	6
PAFZZ	5330-01-061-3002	826102-113	31654	Packing, Preformed	ea		1	2	3
PAOFF	4820-01-065-0848	11054	31654	Valve, Minimum Pressure	ea		1	1	2
PAFZZ		Q4342-514A	07322	Ring Seal, Valve	ea		1	1	2
PAFZZ	5360-01-061-1761	40633	31654	Spring, Valve Inner	ea		1	1	2
PAFZZ	5360-01-061-1760	40272	31654	Spring, Outer Valve	ea		1	1	2
PAFZZ	4820-01-061-5102	20278	31654	Cover, Discharge Valve	ea		1	1	2
PAOZZ	4310-01-061-5406	11399	31654	Kit, Separator	ea		1	2	4
PAFZZ	5360-01-061-1760	40263	31654	Spring, Discharge Valve	ea		1	1	1
PAOZZ	4820-01-065-1769	40273	31654	Diaphragm, Valve	ea		1	1	2
PAFZZ	5330-01-061-3006	40462	31654	Gasket, Flange	ea		1	1	2
PAFZZ	5310-01-061-1459	220035	31654	Washer, Backup	ea		1	1	2
PAFZZ	5330-00-171-7174	600-001-3/8	83259	Washer, Sealing	ea		1	1	2
PAFZZ	5330-01-061-3003	826502-240	31654	Packing, Preformed	ea		1	1	2
PAFZZ	5330-01-061-3004	826502-244	31654	Packing, Preformed	ea		1	1	2
PAFZZ	5330-01-063-3803	826502-259	31654	Packing, Preformed	ea		1	1	2
PAFZZ	5310-01-066-2438	21172	31654	Washer, Backup	ea		1	1	1
PAOZZ	5315-01-061-3439	21636	31654	Screw, Adjusting	ea		1	1	1
PAOZZ		2708-1/2-2A	83719	Pin, Yoke	ea		1	2	4
PAOZZ	5340-00-917-6631	2708-2A	71843	Clevis, Rod End	ea		1	1	1

PRESCRIBED LOAD LIST (PLL), AUTHORIZED STOCKAGE LIST (ASL)--continued

END ITEM: COMPRESSOR, AIR, ROTARY SCREW, 750 CFM, WHEEL MTD (CCE)
MAKE: SULLAIR
MODEL: 750DPQ

MFR PART NO: N/A
NSN: 4310-00-053-3891
SERIAL NUMBER RANGE 35109 TO 35274
DATE: OCT 78

SMR CODE	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	PART DESCRIPTION	U/M	QTY OF PARTS REQ'D FOR NO. OF END ITEM			
						PLL	ASL		
						1-5	1-5	6-20	21-50
PAFZZ	5305-01-063-5043	41264	31654	Screw, Sealing	ea		1	1	1
PAFZZ	4820-01-061-5130	41269	31654	Diaphragm, External	ea		1	2	3
PAFZZ	4820-01-061-5466	41270	31654	Diaphragm, Internal	ea		1	2	3
PAOZZ	5360-01-061-5221	41273	31654	Spring, Return	ea		1	1	2
PAFZZ	2530-01-062-7510	42538	31654	Seal, Cup	ea		1	2	3
PAFFF	4820-01-061-4970	10162BP	75218	Valve, Regulator	ea		1	2	3
PAFZZ	4310-01-065-0677	12548	31654	Kit, Regulator Valve	ea		1	2	4
PAOLL	6140-00-190-9831	20T4A Dry Charge	81348	Battery, 12 Volt	ea		1	2	3
PAFZZ	4820-01-064-9723	12894	31654	Plunger, Valve	ea		1	1	1
PAFZZ	5330-01-061-3007	49202	31654	Gasket, Valve	ea		1	1	1
PAFZZ	4320-01-061-9293	13498	31654	Kit, Seal Shaft	ea		1	2	4
PAFFF	2910-00-089-2370	5228900	72582	Injector assy	ea		2	4	8
PAFFF	2910-00-073-3010	5229649	72582	Kit, Injector	ea		2	4	8
PAFZZ	2910-00-735-6187	5121259	72582	Clamp, Injector	ea		3	6	12
PAFZZ	5310-00-276-3015	5150250	72582	Washer, Clamp	ea		1	2	3
PAFZZ	5305-00-017-9847	179847	72582	Bolt, Clamp	ea		1	2	3
PAFZZ	2910-00-880-0054	5196938	72582	Kit, Fuel Pump	ea		1	2	4
PAFZZ	5330-00-212-6290	5150193	72582	Gasket, Pump	ea		1	2	3
PAFZZ	5330-00-178-3773	5230007	72582	Seal, Pump	ea		1	2	3
PAOZZ	2910-00-050-9838	6436075	72582	Strainer, Fuel	ea		2	4	8
PAOZZ	2910-00-781-1354	5574533	72582	Filter, Fuel assy	ea		1	2	3
PAOZZ	2940-00-462-0328	5134553	72582	Filter assy, Oil	ea		2	3	4
PAOZZ	5360-00-801-8731	5187308	72582	Spring, Element	ea		1	2	3
PAFZZ	2930-00-872-1565	5197508	72582	Kit, Water Pump	ea		2	4	8
PAFZZ	5330-00-847-6223	5117975	72582	Gasket, Body Cover	ea		1	1	2
PAOZZ	6620-00-846-9848	5104832	72582	Thermostat	ea		1	2	3

PRESCRIBED LOAD LIST (PLL), AUTHORIZED STOCKAGE LIST (ASL)--continued

END ITEM: COMPRESSOR, AIR, ROTARY SCREW, 750 CFM, WHEEL MTD (CCE)
MAKE: SULLAIR
MODEL: 750DPQ

MFR PART NO: N/A
NSN: 4310-00-053-3891
SERIAL NUMBER RANGE 35109 TO 35274
DATE: OCT 78

SMR CODE	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	PART DESCRIPTION	U/M	QTY OF PARTS REQ'D FOR NO. OF END ITEM			
						PLL	ASL		
						1-5	1-5	6-20	21-50
PAOZZ	5330-00-961-9806	5132155	72582	Seal, Thermostat	ea		1	2	3
PAOZZ	4310-01-065-0677	P12-4860	18265	Element, Safety	ea	1	1	2	3
PAOZZ	2940-01-062-7413	P12-4861	18265	Element, Primary	ea	1	1	2	4
PAOZZ	4330-01-061-8136	K24003	02249	Element. Oil Filter	ea	1	1	2	4
PAOZZ	5330-01-063-9953	46430	31654	Kit, Gasket	ea	1	1	1	1
PAOZZ	2940-00-755-6584	3800061	07988	Element, Filter	ea	1	1	2	4
PAOZZ	5920-00-519-8715	3136-25	75915	Fuse, Slo-Blo 6-1/4 Amp	ea	1	1	2	4
PAOZZ	2910-00-646-9727	LP535	61112	Cylinder, Ether	ea	1	1	2	4
PAOZZ	3030-00-215-8161	5133768	72582	Belt Set, Engine	ea	1	1	2	3
PAOZZ	2910-01-025-6853	6438839	72582	Element, Strainer	ea	1	2	4	6
PAOZZ	4930-01-027-3592	6438840	72582	Element, Filter	ea	1	2	4	6
PAOZZ	2940-00-580-6283	5573014	72582	Element, Filter	ea	1	2	4	6
PAOZZ	3030-00-758-0716	5133176	72582	Belt Set, Generator	ea	1	1	2	3

APPENDIX H

CROSS REFERENCE LIST

PRIME P/N	PRIME FSCM	SULLAIR P/N	SULLAIR FSCM
AH00-0350	18265	41060	31654
A300	01652	43537	31654
BB1	29676	411111	31654
CB1009-9	76005	44721	31654
C300	01652	49409	31654
C52P	66295	41529	31654
DV750-1	55283	40259	31654
D356AJ	57733	40311	31654
FC107-12	00624	40397	31654
FVG14-0195	18265	46956	31654
GS4	76599	46284	31654
J6642-9	76005	44720	31654
K24003	02249	46428	31654
LFA208D15	02249	46426	31654
LP535	61112	40405	31654
M6280-167SRTM	09393	40374	31654
NH160C300B0650	98265	40327	31654
NK1000063C300	98265	40523	31654
PMP68	99016	43869	31654
P10-5547	18265	40303	31654
P105612	18265	40302	31654
P12-4860	18265	46981	31654
P12-4861	18265	46968	31654
P18188	18265	40364	31654
Q4342	07322	40271	31654
RAX00-2351	18265	45757	31654
RMT172	66295	40305	31654
SAF29G12P	07988	44415	31654
SA1832-24	78388	40457	31654
SR108G	78643	40294	31654
SR108GLH	78643	40295	31654
WAM10-0188	18265	49407	31654
08-810407-026	73168	43374	31654
1-3852	22938	49498	31654
1-4010-5	22938	49506	31654
1-4251	22938	49491	31654
1-4251	22938	49591	31654
1E1995	41197	42170	31654
10162BP	75218	43401	31654
1028-24-24	03924	40292	31654
1036-24-24	03924	40382	31654
10997	53705	44583	31654
12H	66295	40513	31654
1513635	70040	40653	31654
1630	70485	40091	31654
2214	70845	40125	31654

CROSS REFERENCE LIST--continued

PRIME P/N	PRIME FSCM	SULLAIR P/N	SULLAIR FSCM
25AW	76459	40336	31654
2520-1	09393	40463	31654
2708-1/2-2A	71843	40065	31654
2708-2A	71843	40138	31654
3-3620	22938	49504	31654
3AG6	75915	41305	31654
335-2246	22938	14177	31654
335-2296	22938	14176	31654
342838	75915	41304	31654
352AW	57733	40310	31654
36P	66295	40083	31654
361A	57733	40441	31654
369AW	57733	46234	31654
3721-5	95026	49492	31654
3800061	07988	44416	31654
3905-296	22938	49499	31654
3953	22938	49587	31654
3954	22938	49588	31654
4-3620	22938	49512	31654
4-4251	22938	49490	31654
5123880	72582	42160	31654
5162666	72582	49024	31654
5408	22938	49496	31654
5520	13445	40037	31654
5601-7	22938	49507	31654
5653587	70040	40434	31654
6-3807	22938	49495	31654
60SA12X12	30327	40148	31654
600-001-3/8	02697	240047	31654
6000	34494	40276	31654
6057	22938	49592	31654
6058	22938	49593	31654
6151	22938	49591	31654
6152	22938	49590	31654
6251-10	22938	49589	31654
6311	22938	49594	31654
6312	22938	49595	31654
6468087	70040	40307	31654
68B	72100	40313	31654
68FL	30327	20501	31654
70-804-41	16986	40030	31654
74006	32075	42287	31654
7831	50022	47725	31654
8680L23	09393	40641	31654
9C3	14448	40408	31654
9245	13445	40038	31654
94	14448	42047	31654

APPENDIX I

SUPPLEMENTAL HARDWARE LIST

HEX NUTS - STEEL, CAD PLATED

SIZE	MS	NSN
1/4 - 20	51967-2	5310-00-761-6882
5/16 - 18	51967-5	5310-00-880-7744
5/16 - 24	51967-5	5310-00-880-7746
3/8 - 16	51967-8	5310-00-732-0558
1/2 - 13	51967-14	5310-00-768-0318
3/4 - 10	51967-23	5310-00-763-8921

FLAT WASHERS - STEEL, CAD PLATED

1/4"	27183-9	5310-00-823-8804
5/16"	27183-12	5310-00-081-4219
1/2"	27183-17	5310-00-809-5997
5/8"	27183-21	5310-00-823-8803

LOCKWASHERS - STEEL

1/4"	35338-44	5310-00-582-5965
5/16"	35388-45	5310-00-407-9566
3/8"	35388-46	5310-00-637-9541
7/16"	35388-47	5310-00-209-0965
1/2"	35388-48	5310-00-584-5272
5/8"	35388-50	5310-00-820-6653
3/4"	35388-51	5310-00-584-7888

CAP SCREW, HEX HD - SAE #5 CAD PLATED

SIZE	MS	NSN
5/16" X 3/4 - 18	90725-32	5306-00-225-8497
5/16" X 1 - 18	90725-34	5306-00-225-8499
5/16" X 1-1/2 - 18	90725-38	5306-00-225-8502
5/16" X 2 - 18	90725-40	5306-00-225-8504
5/16" X 2-1/2 - 18	90725-42	5306-00-225-8506
5/16" X 2 - 24	90725-40	5306-00-225-9095
3/8" X 1 - 16	90725-60	5305-00-269-3211
3/8" X 2-1/2 - 16	90725-68	5305-00-269-2810
3/8" X 4 - 24	90725-74	5305-00-269-2818
7/16" X 1-3/4 - 14	90725-90	5305-00-042-9478
1/2" X 1/2 - 13	90725-104	5305-00-071-1767
1/2" X 1-1/4 - 13	97025-111	5305-00-782-9495
1/2" X 1-1/2 - 13	90725-113	5305-00-042-6417
1/2" X 2-1/2 - 13	90725-117	5305-00-716-8128
5/8" X 1-1/2 -11	90725-162	5305-00-724-5910
5/8" X 3-1/2 - 11	90725-170	5305-00-725-4138
3/4" X 1-1/2 - 10	90725-185	5305-00-880-4012

APPENDIX J

DETROIT DIESEL PARTS MANUAL INSTRUCTIONS

Detroit Diesel Engine Model 7063-7000 is used in the Sullair 750 CFM Compressor. A parts breakdown of this engine is provided in Volume 3 (Engine Parts List) of the Sullair compressor manual. The following is provided to assist in locating engine repair parts:

1. Refer to page 1 of volume 3, locate the applicable group name, group number, and type.

   Example: Group Name - Fuel Injector C60
   Group No - 2.1000A
   Type - 97

2. Next turn to section 2.0000, titled Fuel System.

3. Now locate the applicable illustration and subgroup.

   Example: Illustration - Fig. 1B
   Subgroup - 2.1200

4. Next locate the subgroup in the parts listing.

   Example: 2.1200 - Retainer, Injector gear.

5. Now refer to the top of the page and locate Type 97.

6. Follow the column under Type 97 down the page to subgroup 2.1200.

7. As indicated, the part number for the Valve is 5228694.

NOTE

The TYPE code will vary from group to group.
(Refer to page 1 of engine parts list.)

APPENDIX K

PREVENTIVE MAINTENANCE CHECKS AND SERVICES

K-1. Maintenance Forms and Records.

Every mission begins and ends with the paperwork. There isn't much of it, but you have to keep it up. The forms and records you fill out have several uses. They are a permanent record of the services, repairs, and modifications made on your equipment; they are reports to organizational maintenance and to your commander; and they are a checklist for you when you want to know what is wrong with the equipment after its last use, and whether those faults have been fixed. For the information you need on forms and records, see TM 38-750.

K-2. Operator/Crew Preventive Maintenance Checks and Services.

a. Do your (B) PREVENTIVE MAINTENANCE just before you operate the equipment. Pay attention to the CAUTIONS and WARNINGS.

b. Do your (D) PREVENTIVE MAINTENANCE while you operate the equipment and at halts or rest stops.

c. Do your (A) PREVENTIVE MAINTENANCE right after operating the equipment. Pay attention to the CAUTIONS and WARNINGS.

d. Do your (W) PREVENTIVE MAINTENANCE weekly.

e. Do your (M) PREVENTIVE MAINTENANCE once a month.

f. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.

g. Always do your preventive maintenance in the same order, so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

h. If anything looks wrong and you can't fix it, write it on your DA Form 2404. If you find something seriously wrong, report it to organizational maintenance RIGHT NOW.

i. When you do your preventive maintenance, take along the tools you need to make all the checks. You always need a rag or two.

(1) Keep it clean: Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use drycleaning solvent (SD-2) to clean metal surfaces. Use soap and water when you clean rubber or plastic material.

(2) Bolts, nuts, and screws: Check that they are not loose, missing, bent, or broken. You can't try them all with a tool, of course, but look for chipped paint, bare metal, or rust around bolt heads. If you find one loose, tighten it or report it to organizational maintenance.

(3) Welds: Look for loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to organizational maintenance.

(4) Electric wires and connectors: Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connectors and make sure the wires are in good condition.

(5) Hoses and fluid lines: Look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots show leaks, of course, but a stain around a fitting or connector can also mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report it to organizational maintenance.

j. It is necessary for you to know how fluid leakage affects the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them and REMEMBER - When in doubt, notify your supervisor!

Leakage Definitions for Operator/Crew PMCS

CLASS I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
CLASS II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
CLASS III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

Equipment operation is allowable with minor leakage (Class I or II). Of course, consideration must be given to the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be reported to your supervisor or to organizational maintenance.

Operator/Crew Preventive Maintenance Checks and Services

B-Before D-During A-After W-Weekly M-Monthly

Item no.	Interval					ITEM TO BE INSPECTED Procedure: Check for and have repaired, filled, or adjusted as needed	Equipment is not ready/ available if:
	B	D	A	W	M		
						NOTE PERFORM WEEKLY AS WELL AS BEFORE PMCS's IF: a. You are the assigned operator but have not operated equipment since the last weekly. b. You are operating the equipment for the first time.	
1.						GENERAL	
	●					a. Visually check for loose wiring or damaged piping.	
	●	●				b. Look for evidence of fluid leakage (oil, fuel, coolant).	Class III leaks or any fuel leaks are found.
2.						TIRES	
	●					a. Check for cuts.	One or more tires missing or flat.
				●		b. Check for correct air pressure - 45 psi (379 kpa).	
3.	●					DRAWBAR	
						Visually check for excessive wear, corrosion, cracked, bent, or deformed parts.	Drawbar broken, cracked, etc.

Operator/Crew Preventive Maintenance Checks and Services--continued

Item no.	Interval					ITEM TO BE INSPECTED Procedure: Check for and have repaired, filled, or adjusted as needed	Equipment is not ready/available if:
	B	D	A	W	M		
4.	●					PARKING BRAKE	
						Check for proper operation.	Parking brake will not engage.
5.	●					ENGINE CRANKCASE	
						Check dipstick for proper level. Add oil as necessary to FULL mark.	
6.	●					RADIATOR	
						Check coolant level. Add coolant as required. (Level should be approximately 1 inch from bottom of filler neck.)	
7.						COMPRESSOR SUMP	
	●			●		a. Check oil level by sight gage. Add as required.	
		●				b. Monitor oil level. CAUTION Before servicing air or compressor oil system, open relief valve to atmosphere to relieve all pressure in system.	

Operator/Crew Preventive Maintenance Checks and Services--continued

Item no.	Interval					ITEM TO BE INSPECTED Procedure: Check for and have repaired, filled, or adjusted as needed	Equipment is not ready/ available if:
	B	D	A	W	M		
8.						CONTROLS AND INSTRUMENTS	
						Check for proper indication and operation.	
		●				Engine Coolant Temperature Gage ----------- 160° - 210°F (71 - 104°C).	
		●				Engine Oil Pressure Gage ------------------ 40 - 60 psi at 1050 rpm (idle speed).	
		●				Ammeter ------------------------------------ Slight (+) charge	
		●				Compressor Discharge Temperature Gage ----- 180°F (82°C) approximate normal reading.	
		●				Air Pressure Gage ------------------------- 40 - 100 psi normal operation	
		●				Tach-Hourmeter ---------------------------- 1050 rpm (idle speed)	
		●				Tach-Hourmeter ---------------------------- 2100 rpm (load speed).	
9.						AIR FILTERS (Engine and Compressor)	
		●				a. Check air cleaner indicator. If red, clean and service.	
					●	b. Inspect air cleaner element.	

Operator/Crew Preventive Maintenance Checks and Services--continued

Item no.	Interval					ITEM TO BE INSPECTED Procedure: Check for and have repaired, filled, or adjusted as needed	Equipment is not ready/ available if:
	B	D	A	W	M		
10.						PRESSURE RELIEF VALVE	
			●			a. Upon shutdown check to insure pressure is released.	Relief valve fails to release pressure.
				●		b. Manually pop pressure relief valve to check operation.	
11.				●		V-BELTS	
						Check for frayed, cracked, or broken belts.	V-belts missing.
12.					●	BATTERIES	
						Check fluid level. Fill as required to split ring. Inspect for obvious defects, such as cracked case, burnt, broken, or loose battery terminals and cables.	One or more missing or will not crank engine.

K-3. General.

To insure that the air compressor is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The PMCS contains a tabulated listing of preventive maintenance checks and services to be performed by organizational maintenance personnel. All deficiencies and shortcomings will be recorded as well as the corrective action taken on DA Form 2404 at the earliest possible opportunity.

K-4. Organizational Preventive Maintenance Checks and Services.

a. The item numbers indicate the sequence of the PMCS. Perform at the intervals shown below:

(1) Do your (Q) PREVENTIVE MAINTENANCE once each 3 months.

(2) Do your (S) PREVENTIVE MAINTENANCE twice a year, or each 6 months.

(3) Do your (A) PREVENTIVE MAINTENANCE once each year.

(4) Do your (B) PREVENTIVE MAINTENANCE once each two years.

(5) Do your (H) PREVENTIVE MAINTENANCE at the hour interval listed.

(6) Do your (MI) PREVENTIVE MAINTENANCE when the mileage of the vehicle reaches the amount listed.

b. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.

c. Always do your preventive maintenance in the same order, so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

d. If anything looks wrong and you can't fix it, write it down on your DA Form 2404. If you find something seriously wrong, report it to direct support as soon as possible.

(1) Keep it clean: Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use drycleaning solvent (SD-2) to clean metal surfaces. Use soap and water when you clean rubber or plastic material.

(2) Bolts, nuts, and screws: Check that they are not loose, missing, bent, or broken. You can't try them all with a tool, of course, but look for chipped paint, bare metal, or rust around bolt heads. Tighten any that you find loose.

(3) Welds: Look for loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to direct support.

(4) Electric wires and connectors: Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connections and make sure the wires are in good condition.

(5) Hoses and fluid lines: Look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots show leaks, of course, but a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, either correct it or report it to direct support (refer to MAC chart, appendix C).

e. It is necessary for you to know how fluid leaks affect the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them and REMEMBER - When in doubt, notify your supervisor!

Leakage definitions for Organizational PMCS

CLASS I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
CLASS II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from the item being checked/inspected.
CLASS III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

Equipment operation is allowable with minor leakages (Class I or II). Of course, consideration must be given to the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be corrected before releasing equipment for operation.

Organizational Preventive Maintenance Checks and Services

Legend

Q-Quarterly	A-Annually	H-Hours
S-Semiannually	B-Biennially	MI-Miles

Item no.	Interval Q	S	A	B	H	MI	ITEM TO BE INSPECTED Procedure
1.	●						ENGINE
							Check for leaks, loose mounts, and proper operation.
2.					100		Oil Filter
							Change oil and filter, vol 2 page 63.
3.					200		Fuel Filter
							Change filter, vol 2 page 65.
4.					200		V-Belts
							Check tension, vol 2 page 69.
5.					200		Radiator
							Check for leaks and clean exterior as required.
			●				Check antifreeze protection.
				●			Drain and flush radiator and engine.
6.					1000		Air filter
							Primary element should not be cleaned more than 5 times.
							Replace at sixth time or yearly.
							Secondary element must be changed at sixth primary element change or yearly. *DO NOT CLEAN SECONDARY ELEMENT*.
7.	●						COMPRESSOR
							Check for leaks, loose fittings, and proper operation.
8.					500		Main Oil Filter
							Clean and/or replace filter as required, vol 1 page 15.

Organizational Preventive Maintenance Checks and Services

Item no.	Interval						ITEM TO BE INSPECTED Procedure
	Q	S	A	B	H	MI	
9.					500		Sump Drain and refill. Clean oil filler cap before filling sump, vol 1 page 14.
10.					500		Bearing Filter Change filter, vol 2 page 15.
11.					500		Control Linkage Check operation and lubricate.
12.			●				Oil Separator Inspect element. NOTE Average life of oil separator element is between 10,000 and 25,000 hours.
13.					1000		Air Filter Same as Item #6 above.
14.			●				Wheel Bearings Clean and repack, vol 1 page 15.
15.	●						Running Gear Clean, inspect, and lubricate as required, vol 1 page 15.
16.	●						Parking Brake Clean, inspect, and lubricate as required, vol 1 page 15.
17.			●				Drawbar and Frame Clean and check for excessive wear, corrosion, and cracked, bent, or deformed parts.
18.			●				Gages Check operation.

Organizational Preventive Maintenance Checks and Services

Item no.	Interval Q	S	A	B	H	MI	ITEM TO BE INSPECTED Procedure
19.	●						Pressure Relief Valve Manually pop pressure relief valve to check operation.
20.			●				General Check for loose wiring.

APPENDIX L

ADDITIONAL LUBRICATION GUIDANCE

The following is provided as a reference to assist in locating and performing lubrication on the compressor and engine:

1. All intervals are based on normal hours of operation. Adjustments will be made to compensate for abnormal operations and severe conditions. During inactive periods, sufficient lubrication must be performed for adequate preservation.

CAUTION

Before servicing air or compressor oil system, open relief valve to atmosphere to relieve all pressure in system. (Ref vol 1, section A, para A.3, H.)

2. General compressor lubrication information is contained in volume 1, section 2.

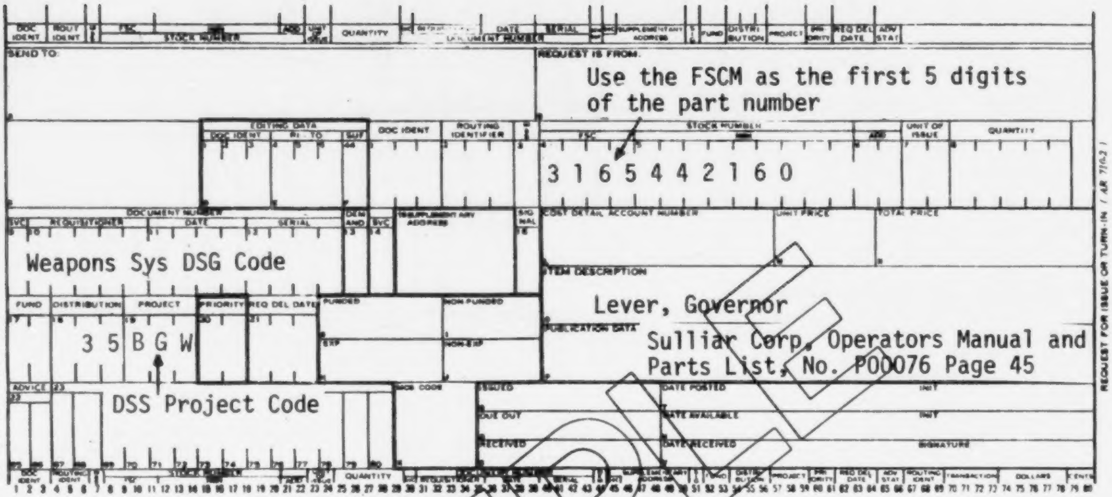
3. Section 4 of volume 1 contains specific requirements for changing the compressor sump oil, filters, and for lubricating the running gear.

4. Volume 2, pages 61 thru 80, contains the information for lubrication of the diesel engine.

5. Refer to appendix F of this publication for the recommended NSN's for fuels, lubricants, and coolants.

6. Lubrication procedures for the air compressor are contained in LO 5-4310-251-12.

APPENDIX M



Use the FSCM as the first 5 digits of the part number

3 1 6 5 4 4 2 1 6 0

Weapons Sys DSG Code

Lever, Governor

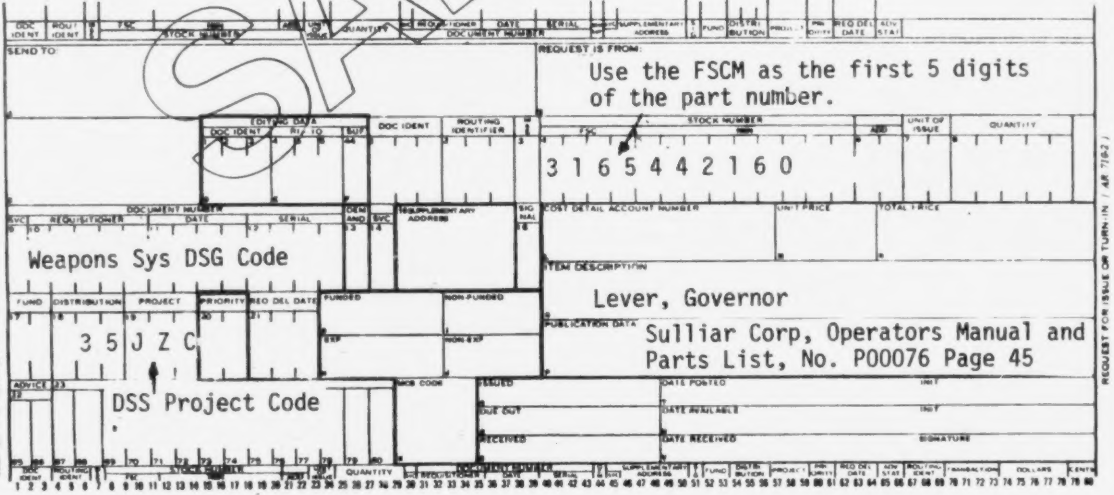
Sulliar Corp, Operators Manual and Parts List, No. P00076 Page 45

3 5 B G W

DSS Project Code

Sample format - DA Form 2765 Part number request (CONUS REQUESTER)

SAMPLE



Use the FSCM as the first 5 digits of the part number.

3 1 6 5 4 4 2 1 6 0

Weapons Sys DSG Code

Lever, Governor

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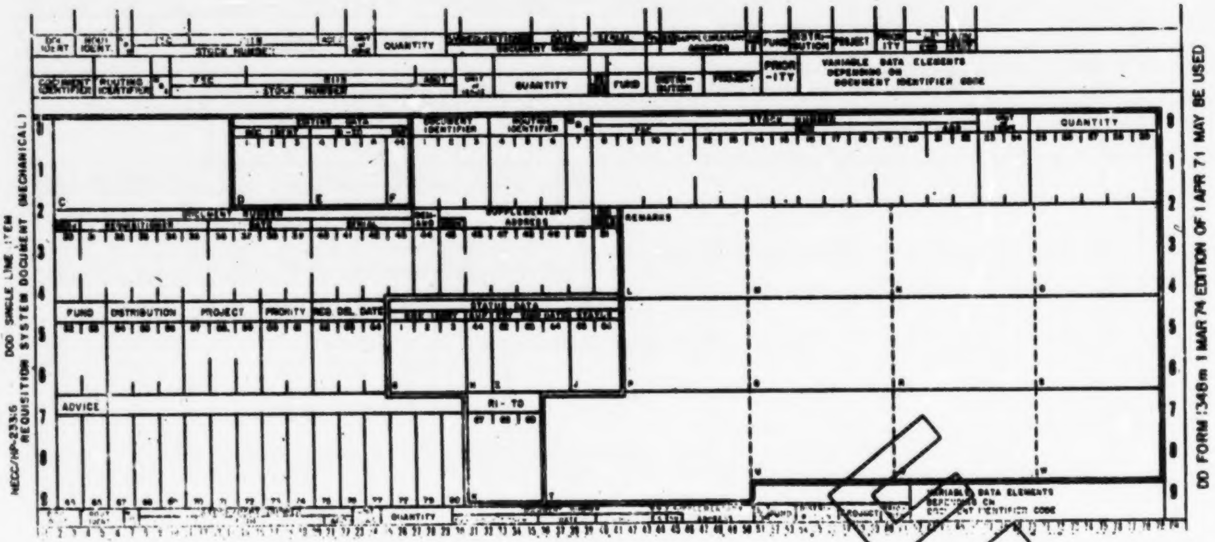
3 5 J Z C

DSS Project Code

Sample format - DA Form 2765 Part number request (OCONUS REQUESTER)

TA072409

APPENDIX N



NECC/HP-2336 DOD SINGLE LINE ITEM REQUISITION SYSTEM DOCUMENT (MECHANICAL)

DD FORM 1348m 1 MAR 74 EDITION OF 1 APR 71 MAY BE USED

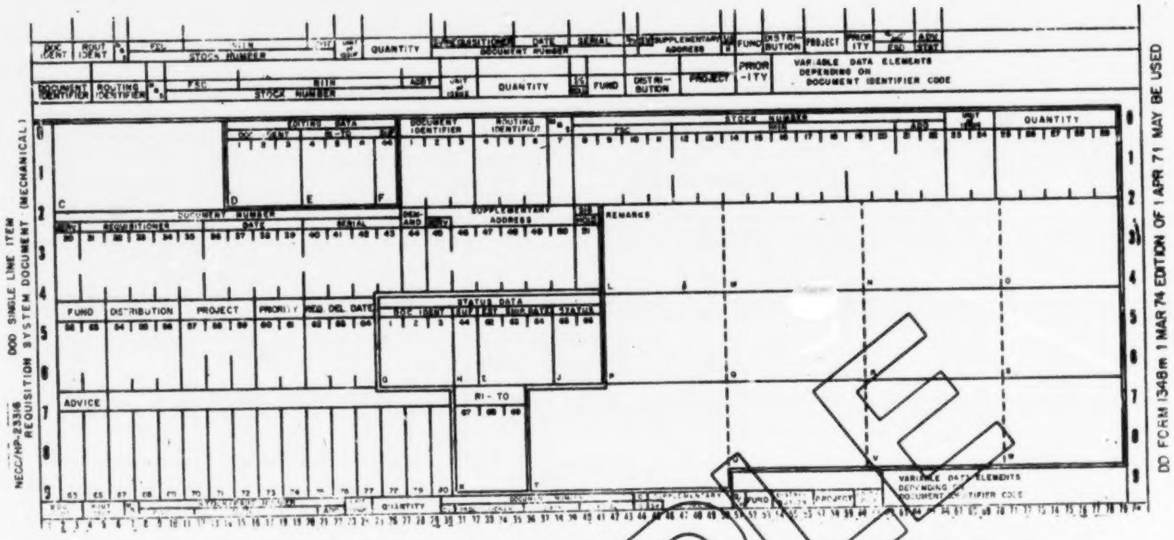
SAMPLE

Card Column	Description of Data	Mandatory Entry for CCE
1-3	Document Identifier Code	A0A - CONUS A01 - Overseas
4-6	Routing Identifier Code	
7	Media/Status Code	
8-22	NSN	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	"F" for CONUS; see AR 725-50 for OCONUS
	CC-55-56	Weapons System Code (DSS) Code
57-59	Project Code	
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	

Sample format - Milstrip requisition for CCE (NSN)

TA072410

APPENDIX O


DOD SINGLE LINE ITEM REQUISITION SYSTEM DOCUMENT (MECHANICAL)
NECC/HP-23316
DD FORM 1348m 1 MAR 74 EDITION OF 1 APR 71 MAY BE USED
DOCUMENT IDENTIFIER
ROUTING IDENTIFIER
STOCK NUMBER
QUANTITY
DOCUMENT NUMBER
SUPPLEMENTARY ADDRESS
FUND
DISTRIBUTION
PROJECT
PRIORITY
REQ. DEL. DATE
STATUS DATA
ADVICE
REMARKS
RI - TO
VARIABLE DATA ELEMENTS DEPENDING ON DOCUMENT IDENTIFIER CODE

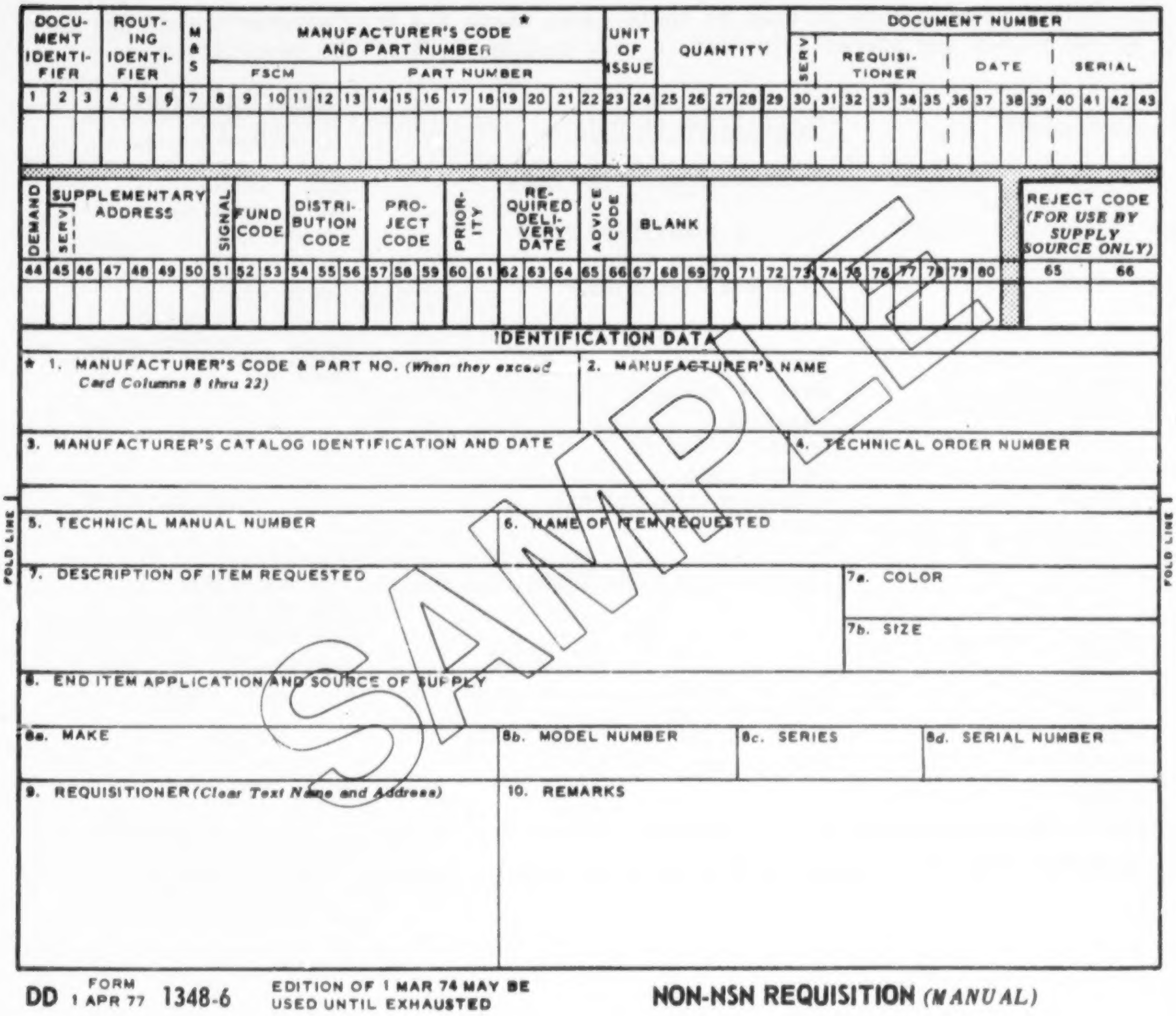
SAMPLE

CARD COLUMN	DESCRIPTION OF DATA	MANDATORY ENTRY FOR CCE
1-3	Document Identifier Code	A0B - CONUS A02 - Overseas
4-6	Routing Identifier Code	Always S9C
7	Media/Status Code	
8-22	FSCM and Part Number	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	"F" for CONUS; see AR 725-50 for OCONUS
	CC-55-56	Weapons System Code
57-59	Project Code	CCE (DSS) Code
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	
67-69	Blank	
70	Identification code applicable to entry in cc 71-80. A - Technical order or Technical Manual. B - End Item Identification C - Noun Description D - Drawing or Specification No.	
71-80	Reference Identification	Identification of reference specified in cc 70.

Sample format - MILSTRIP requisition for CCE (Non-NSN).

TA072411

APPENDIX P



DOCUMENT IDENTIFIER	ROUTING IDENTIFIER	M & S	MANUFACTURER'S CODE AND PART NUMBER *		UNIT OF ISSUE	QUANTITY	DOCUMENT NUMBER			
			FSCM	PART NUMBER			SERV	REQUISITIONER	DATE	SERIAL
1 2 3	4 5 6	7	8 9 10 11 12	13 14 15 16 17 18 19 20 21 22	23 24	25 26 27 28 29	30	31 32 33 34 35	36 37 38 39	40 41 42 43

DEMAND	SUPPLEMENTARY ADDRESS		SIGNAL	FUND CODE	DISTRIBUTION CODE	PROJECT CODE	PRIORITY	REQUIRED DELIVERY DATE	ADVICE CODE	BLANK		REJECT CODE (FOR USE BY SUPPLY SOURCE ONLY)	
	SERV												
44	45 46	47 48 49 50	51	52 53	54 55 56	57 58 59	60 61	62 63 64	65 66	67 68 69	70 71 72 73 74 75 76 77 78 79 80	65	66

IDENTIFICATION DATA

* 1. MANUFACTURER'S CODE & PART NO. *(When they exceed Card Columns 8 thru 22)*

2. MANUFACTURER'S NAME

3. MANUFACTURER'S CATALOG IDENTIFICATION AND DATE

4. TECHNICAL ORDER NUMBER

FOLD LINE

5. TECHNICAL MANUAL NUMBER

6. NAME OF ITEM REQUESTED

FOLD LINE

7. DESCRIPTION OF ITEM REQUESTED

7a. COLOR

7b. SIZE

8. END ITEM APPLICATION AND SOURCE OF SUPPLY

8a. MAKE

8b. MODEL NUMBER

8c. SERIES

8d. SERIAL NUMBER

9. REQUISITIONER *(Clear Text Name and Address)*

10. REMARKS

DD FORM 1 APR 77 **1348-6** EDITION OF 1 MAR 74 MAY BE USED UNTIL EXHAUSTED **NON-NSN REQUISITION** ***(MANUAL)***

SAMPLE

Sample Format - MILSTRIP requisition for CCE (Non-NSN) (Manual)

INSTRUCTIONS

This form will only be used in those cases where the manufacturer's code and part number exceed the spaces allocated in card columns 8-22 of the requisition.

CARD COLUMN	DESCRIPTION OF DATA	MANDATORY ENTRY FOR CCE
1-3	Document Identifier Code	A0E - CONUS A05 - Overseas
4-6	Routing Identifier Code	Always S9C
7	Media/Status Code	
8-22	FSCM and Part Number	Leave blank Enter in Block 1 under Identification Data
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	"F" for CONUS; see AR 725-50 for OCONUS
	CC-55-56	Weapons System Code
57-59	Project Code	CCE (DDS) Code
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	
67-80		Blank

IDENTIFICATION DATA - Lower half of DD Form 1348-6, complete Blocks 1 thru 9.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25A, Operator maintenance requirements for Air Compressors, 600 CFM.

☆U.S. GOVERNMENT PRINTING OFFICE: 1983- 242-451/05862

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN. . JOT DOWN THE DOPE ABOUT IT ON THIS FORM, CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 5-4310-451-14&P	14 Dec 79	Compressor, Air, Rotary Screw

BE EXACT. . .PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO	

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER	SIGN HERE:

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

TEAR ALONG PERFORATED LINE

FILL IN YOUR
UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

____

____

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

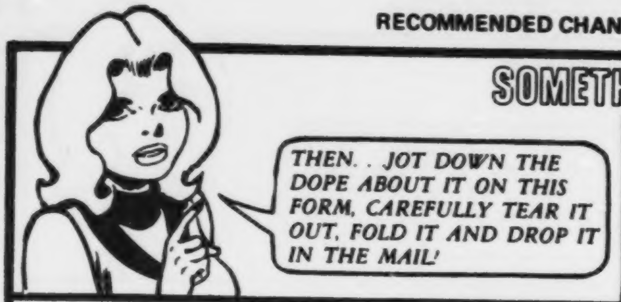
POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314

U.S.MAIL

Commander
US Army Tank-Automotive Materiel Readiness Command
ATTN: DRSTA-MB
Warren, MI 48090

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS


THEN. . JOT DOWN THE DOPE ABOUT IT ON THIS FORM, CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

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DATE SENT

PUBLICATION NUMBER TM 5-4310-451-14&P	PUBLICATION DATE 14 Dec 79	PUBLICATION TITLE Compressor, Air, Rotary Screw

BE EXACT. . .PIN-POINT WHERE IT IS

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REVERSE OF DA FORM 2028-2

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Warren, MI 48090

TEAR ALONG PERFORATED LINE

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

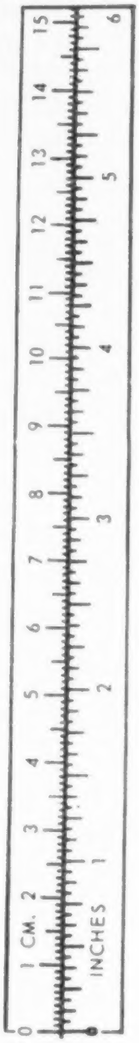
TEMPERATURE

$5/9\,({}^{0}F - 32) = {}^{0}C$
212^{0} Fahrenheit is equivalent to 100^{0} Celsius
90^{0} Fahrenheit is equivalent to 32.2^{0} Celsius
32^{0} Fahrenheit is equivalent to 0^{0} Celsius
$9/5\,C^{0} + 32 = F^{0}$

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	**Miles per Hour**	**0.621**



TA089991